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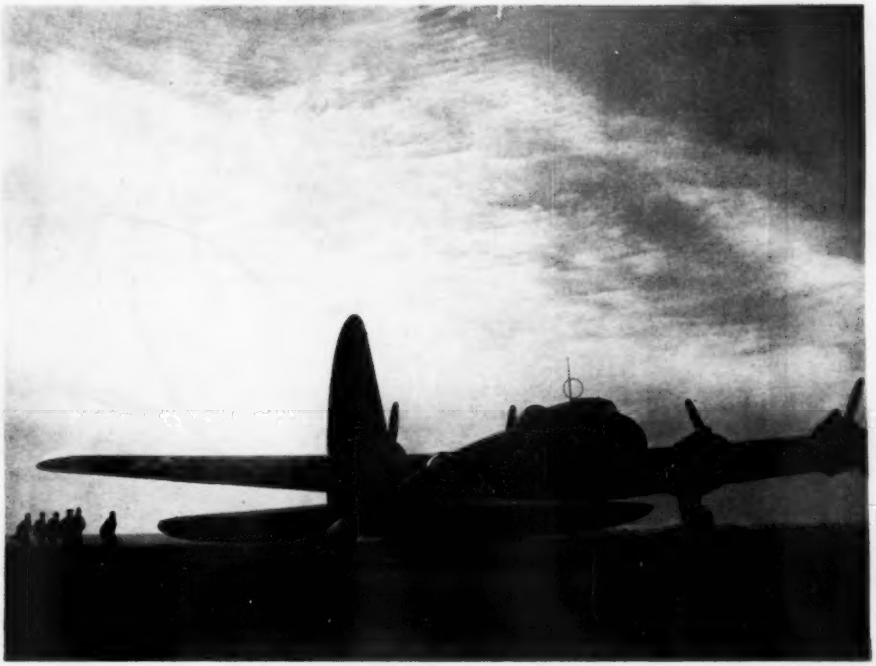
The Science Teacher



YB-17 DUSK PATROL, LANGLEY FIELD
Official OWI Photo by Palmer.

IN THIS ISSUE . . .

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OCTOBER
DECEMBER
FEBRUARY
APRIL

A National Service Journal

A Spencer Microscope being used aboard a United States heavy cruiser.

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The Science Teacher

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Report "Teaching Suggestions for P. I. T. Bulletin 101, Fundamentals of Electricity"*

R. WILL BURNETT
Stanford University

These suggestions come from the experience of practical science teachers and are presented for your use in pre-induction training courses in our schools.—EDITOR.

THE NEEDS of the Army for large numbers of men with basic understanding in certain specialized fields were recognized by the publication in 1942 of a series of bulletins prepared jointly by the U. S. Office of Education and the Civilian Pre-Induction Training Branch of the Industrial Personnel Division, Army Service Forces (not the Pre-Induction Training Branch of the Military Training Division, Army Service Forces). These bulletins suggested that schools might provide special training for prospective inductees, so that the training received after induction would be facilitated.

In the bulletin Fundamentals of Electricity (PIT-101), an organization of subject matter to be studied was provided under thirteen headings. This topical arrangement and scope followed quite generally that of the traditional high school course in Physics, usually undertaken by approximately 20 per cent of high school boys. It was recommended that such boys pursue the customary course with special emphasis on military applications of principles studied. It was further suggested that for those boys who would not normally study a course in physics, special pre-induction courses be designed covering the same general topics but with decided emphasis upon actual experience with electrical devices, and upon as much opportunity for development of manipulative skill and understanding as could be provided. Thus a substantial foundation for post-induction training could be established.

Experience Indicates a Need for Supplementing the Bulletins

Fundamentals of Electricity (PIT-101) has been used as the basis for the organization of pre-induction training courses in electricity in which an estimated one hundred thousand students were enrolled during the year 1942-1943. It is the purpose of the present supplement to suggest a more definite focus upon Army needs that may prove of further help to teachers in this field. A number of applications of the principles of electricity to specific Army problems and situations are cited. These may be particularly useful to teachers whose opportunities for acquiring first-hand information have been limited. The supplement also recognizes the needs of those teachers whose previous experiences may have been in other fields and who are giving emergency service as teachers of pre-induction courses.

ATTENTION is called to the difference between a pre-induction course in electricity and the treatment of the corresponding material in the regular high school course in Physics. This differentiation is made necessary by the fact that the largest needs of the Army call

*This report was drawn up by R. Will Burnett, Assistant Professor of Science Education, Stanford University, formerly consultant of the Pre-induction Training Branch of the War Department. The following persons collaborated in the report: Philip G. Johnson, Cornell University; Lester Williard, Elizabeth, New Jersey; Nelson Becker, Albany, New York; Millard W. Bosworth, Vermont Academy, Santon River, Vermont; and Wendell P. Gee, Detroit, Michigan.

only for basic understandings in the field of science, although obviously any amount of science training will be valuable. Furthermore, the ordinary course in high school physics cannot be mastered by all boys; and if such a course is required for a normal high school population, the percentage of failures will be high.

To assist the teacher in focusing upon suitable applications of the basic principles of electricity, an illustrative treatment is presented for the thirteen topics of the outline in *Fundamentals of Electricity (PIT-101)*. For each topic a brief statement of its application to military life is given, followed by several suggested activities of the kind which will be interesting and meaningful in terms of the soldier's post-induction training.

THERE is no thought of dictating a procedure to be followed. On the contrary, the illustrative activities should be considered as representative of the types of learning experiences by which the student who has not undertaken the traditional course in physics may achieve some understanding of principles, and may acquire considerable skill in working with devices in which principles find application.

Two cautions should be mentioned here. First, a course of this type should not be established as a substitute for a vocational course where the school has facilities for providing job skill training. Second, the enrollment in the Fundamentals of Electricity course should not arbitrarily include those students in the upper 20 per cent of ability who ought to be securing a thorough grounding in college preparatory physics.

It is hoped that the teacher of the course in Fundamentals of Electricity will utilize the present publication as a supplement to the basic bulletin and not in any sense as a replacement of it. Its purpose will be achieved if it suggests classroom procedure appropriate to the requirements of prospective inductees and to Army needs.

A Suggested Plan of Procedure

THE USUAL academic approach to the study of physics will scarcely meet the requirements of the typical prospective inductee, at the low level of a course limited to the basic fundamentals of electricity and their applications. It is well to bear in mind that the majority of students here reached would not elect college-preparatory physics, often for justifiable reason. It will be evident, too, that among the students there will occur a great range of interest and experience, as well as of natural aptitude. Recognition of this fact at the outset, and early discovery of interests and limitations of capacity are of paramount importance, if the study of electricity is to result in the greatest good for the greatest number.

Laboratory experience should not be confined to the use of materials and apparatus of the usual course in physics, some of which by virtue of its size and the finesse with which it must be manipulated, may seem fairly meaningless to the student who is encountering everyday applications of electrical principles. A comparison of the discharge of electricity from a pith ball with the grounding of the delivery hose of a gasoline truck illustrates this point.

The amount and kind of useful apparatus procured from the usual sources may be limited. For example, it may not be possible to borrow enough equipment from the physics laboratory.

THE STUDENT will find himself a much more active participant in learning situations if he brings parts of usable equipment from outside sources. This will be particularly advantageous to the teacher with little experience or training in this area who frankly admits to his students that he and they will work through many of their learning experiences together.

Having suitable equipment ready for use at the time of need is of strategic importance in a course of this sort. Emphasis throughout should be placed on a sequence of activities which provides for individual interests and aptitudes; activities of this type call for equipment which is real to the student in terms of outside applications. Arrangements may sometimes be made with local electricians for temporary use of their equipment. In addition, many excellent motion pictures[1] and slidefilms may be secured on a rental or purchase basis.

Adapting the Course to the Requirements of Army Jobs

THE GOAL in pre-induction training in electricity should be to aid the student as far as possible in the development of basic insights and skills upon which the Army may expeditiously provide post-induction training to fit the boy for the job he will do in Army life. Descriptions of Army jobs,[2] therefore, may be illuminating to the teacher, in that they suggest the type of preparation needed for the work that many of the boys now in school will be doing in their Army life.

Learning experiences should be directed as closely as possible to the fundamental knowledges and skills essential to Army job activities. Keeping Army needs in mind will tend to prevent time-consuming consideration of theory related only remotely to the immediate problem.

Some Further Suggestions for the Planning of Activities

Only those activities should be planned that can be justified in terms of the student's capacity for learning. In devolping the course, the teacher will wish to determine the ability levels represented in the class, and to think of attainable goals for each individual.

The students' earlier experience with or information about the phenomena to be studied may well be made the introductory step in the classroom or laboratory procedure. Students will be found to have varied acquaintance with and interests in the topics studied. For example, some boys may have had experience in working with small electric motors in various hobbies; others may have acquired some skill in minor electrical repair work around the home. Previous experience should be recognized and individuals should be given as much opportunity for growth as time and facilities will permit.

SOME STUDENTS will wish to extend their work in certain areas. It should be possible for such students to undertake individual projects on which reports to the group may be made, through demonstrations, drawings of apparatus, or some other activity.

Reference books and pertinent Army Field Manuals and Technical Manuals should be readily accessible to students. A list of these manuals may be procured without charge from the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C.

The effectiveness of the learning experiences of the prospective inductee will be evaluated in terms of Army service rendered. Perhaps nowhere else in our system of education will its product be put more immediately to a real test of its value. Appreciation of this fact by instructor and student is essential to effective teaching and learning. Theory is of value only as it leads immediately to an understanding of its applications in military situations.

I. MAGNETISM

MAGENITISM in temporary (electro-) or permanent form, has applications in a great variety of devices essential to military operations. It occurs in the magnetic compass; in instruments of communication such as the telephone, telegraph, and radio; in eletcric motors, generators, magnetos, bells, circuit breakers, relays, and automatic switches; in bomb-release mechanisms of airplanes, in land-mine deterctors, in magnetic mines, and in many other military devices.

For most of these applications, electromagnetism is involved. This chapter, however, deals with magnetism in its permanent form, particularly as manifested in the compass. The principles of magnetism may be studied here, since they apply to either form.

The student should be led to understand the practical applications of magentism. To accomplish this, he will need basic knowledge of the principles of magnetism. It should be remembered that the outcome desired in post-induction training is insight and skill in work-

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1—See the section on visual aids in the field of electricity in the "Bibliography of Visual Aids for Pre-Induction Training." This may be procured without charge from the U. S. Office of Education, Washington, D. C., or the Civilian Pre-Induction Training Branch of the War Department, Pentagon Building, Washington, D.C.

2—See *Army Regulations Number* 615-26 for a description of the 650 Army job specialties. Selected for descriptions are also given in:

PIT-331: *Pre-Induction Vocational Training in Auto Mechanics.*

PIT-332: *Pre-Induction Vocational Training in Machine Shop Practice.*

PIT 333: *Pre-Induction Vocational Training in Aircraft Maintenance.*

PIT 334: *Pre-Induction Vocational Training in Electrical Signal Communication.*

Editorial and News

Keys to Success in Association Work

WOULD you accept the keys to a city? Such an honor would surely be accepted if you considered yourself worthy. But what of the keys to success in science teacher association work? Are you willing to accept them? Very definitely the keys to success in association work are these three—*organize, affiliate, and work together*. These are within the reach of all interested teachers.

This is no time to "let George do it." It is a time to assume some leadership and get things done. Hold up the idea of organization among your comrades in science where-ever you meet them—in private, in your own school, at luncheon, in local or city associations, in local divisions of your state education association, or in state teachers' meetings. Other teachers know it is their duty to organize and work together. Once the idea is presented, others will fall in line and help push it along. Soon an organization will be completed and the first step is done.

MANY LOCAL divisions of state teachers' associations are meeting now in spite of war restrictions and offer splendid opportunities for organization work. School masters' clubs and other teacher organizations exist and provide further opportunities. Whenever possible a science group should be organized and set to work. Growth can only come through work.

But organizing locally is not enough. If an organization is to be most successful, workmen know that it must be affiliated with some national organization to give it stability and strength and to help it function in a larger way. Many science teacher groups are recognizing this essential principle and are affiliating with some national association. Many others need to follow the same plan to the end that complete cooperative action can be obtained on matters of common concern as is the case in searching out and using core material in the Pre-Induction Training program in the schools.

AFFILIATING with a national association does not destroy the independence of action or the initiative of the local group. Instead, it opens larger opportunities for service and stimulates activity as do national civic service clubs for their local units.

Finally, a most important key to success in science teacher association work is for organized groups to work together cooperatively. Considerable progress is being made in this direction as is pointed out by Mr. Neal in his *Council Notes* on page eleven of this issue. However, further growth in cooperative action is needed and must come.

Begin planning ahead. If a science teachers' organization does not already exist in your area, plan one and be prepared for the first opportunity to organize it, whether this spring or next fall or winter. Usually the ground work is laid in advance by getting in touch with those you consider leaders and winning their support. If you already have an organized group in your area, but it is not affiliated nationally, then working for an affiliation is most urgent. Remember, the time for action is immediate.

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Coming

NOW THAT flying has become so vital in warfare you will want to read "The Physiological Disturbances of Flying" by Professor Chalmers L. Gemmill, Comdr. (Mc) U.S. N.R., U. S. Naval Air Station of Pensacola, Florida. Professor Chalmers is a well known author in this field and also has much practical experience with the air service. He will have a message you will want to read in the April issue. We have released the article for re-publication in South American journals.

Council Notes

Edited by NATHAN A. NEAL, Secretary
AMERICAN COUNCIL OF SCIENCE TEACHERS

One Step in Cooperation

"The Science Teacher," "School Science and Mathematics" and other journals concerned with science teaching have recently published proposals for a united front for all science teacher organizations. It is true that almost everyone concerned with science teaching believes that greater cooperation between existing organizations of science teachers is desirable. All are agreed that closer unification would be an important step toward achieving well formulated goals which often seem quite remote from the present. However, the proposals for closer cooperation raise many practical questions. Probably no individual or group holds all of the answers to these questions. One such question always concerns itself with the problem of what *specific achievements* might be expected from more cooperation. Even this most basic question has sometimes been difficult to answer, and there is, of course, no final answer to this or any of the numerous other problems. Perhaps one answer has appeared in Education for Victory* in the summary of a report prepared by a committee from National Science Teaching Organizations, with the cooperation of the U. S. Office of Education and the Pre-Induction Training Branch of the War Department. This report is intended to amplify health needs with particular reference to the needs of the prospective soldier.

THE REPORT is focused upon the need for the development of knowledge, attitudes, and skills of importance in the future military life of the 16 and 17 year-old boys in the schools today. As a result there are emphases which may differ from those of peacetime instruction, and hence considerable material common to regular courses of study is not included in the content suggested.

The materials outlined are intended only as statements of Army needs. What each instructor does will be determined by the equipment available, by the student's background, and by his knowledge. But it is hoped that this expression of military health needs will give direction to local teaching, and that the activities listed—modified and

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*Educaton for Vctory—Vol. 2, No. 13—Jan. 3, 1944—pp. 9-14.

1944 N.E.A. Convention—Council Meeting

THE EXECUTIVE Committee of the National Education Association, at a recent meeting, set July 5th and 6th for the meeting of the Representatice Assembly. Also it set aside July 4th for Departments to, "meet to transact business and if desired, to arrange a short inspirational and informational program for officers and others in attendance."

The American Council of Science Teachers welcomes the opportunity to hold such a meeting. The exchange of ideas is very beneficial and especially with the needs constantly changing with the rapid progress of the war, it is essential that educators meet to get a better understanding of problems so that they can be met as they arise.

Consequently the Council would like to urge its officers and members to secure places as delegates to the Representative Assembly from their area, thereby assuring a large attendance.

Why not complete plans now to be there?

★

100% Membership In A.C.S.T.

Alma, Michigan

Summitt, N. J.

Official reports of 100% membership have only been received by these two towns or schools. There are many more to be added to this list so send in your membership records now in order to add your school to this list.

Colloidal Graphite

R. K. CARLETON

Rhode Island State College — Kingston, Rhode Island

PROBABLY no single chemical substance is more widely distributed than carbon. Graphite is an allotropic form of that element. Like the diamond, another allotropic form of that element, it is crystalline, but it differs from the diamond in many respects. Instead of being very dense and hard its density is only 2.25 and it among the softest substance known. Hence it has the many industrial uses, among which is the increasing demand for colloidal graphite as a lubricant. It is inert to chemicals and burns only at high temperatures. Even though the amount of artificial graphite is increasing, the mining of natural graphite constitutes an important industry. Most of the graphite used in pencils comes from Mexico; other large deposits are located in Siberia, Austria and Ceylon. Although there are some deposits in the United States, the quality of the graphite and its cost of production make them of minor importance.

ARTIFICIAL graphite is made by volatilizing carbon in electric furnaces at a temperature of about 4000°C; upon condensing, it becomes crystalline. Graphite electrodes, crucibles, and such other products are indispensable to many electrical processes. About 25,000 tons of graphite are imported annually into the United States. The Acheson Graphite Corporation of Niagara Falls is the principal producer of Artificial graphite, although some is produced as a by-product of the silicon carbide[2] industry. It was as an outgrowth of his work on silicon carbide, that Edward Goodrich Acheson in 1896 invented the first successful process for the commercial manufatcure of artificial[3] graphite. He discovered that any form of amorphous carbon, when placed in an electric furnace and subjected to a temperature of approximately 3000°C. was converted into the graphite allotrope. Graphite so produced, could, dependent upon the raw material employed, be obtained in a state of almost perfect purity.

Value of Graphite for Lubrication Purposes

Because of the greasy feel possessed by graphite, its suitability as a dry lubricant has long been recognized. Being a solid which is highly resistant to oxidation and, at the same time, chemically stable under conditions that are destructive to fluid lubricants, graphite is of considerable value as a friction reducer in many industrial applications. This is especially the case where high temperatures are involved; where fluid lubricants are absorbed, as in the case of wood bearings and shafts; and in looms used for the production of laces and textiles where the fabrics being woven are liable to stain from oils and greases.

CAREFULLY machined parts, even though seemingly smooth, reveal, under the microscope, surfaces made up of a multitude of projections and depressions. It is this roughness of the rubbing surfaces that is mainly responsible for friction and wear. If the depressions are filled in or the projections leveled, the co-efficient of friction[4] is reduced.

Dry Graphite, in dust form, when injected between bearings and shafts acts to some extent as a smoothing and polishing agent. When abrasion takes place between unpolished surfaces there is a tendency for the projections of one rubbing member to shear off the peaks of the opposing member. However, when abrasion occurs between parts lubricated with graphite, the particles of the latter, which are weak in cohesive properties, suffer rupture rather than the strongly coherent metallic faces. According to Adam[5], the mechanics of dry graphite lubrication in terms of the structure of the graphite

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2—Silicon carbide is more familiarly known as Carborundum.

3—Artificial in the same sense that manufactured ice is artificial.

4—Coefficient of friction is defined as "that value which when multiplied by the pressure normal to the surface in contact gives the measure of the maximum frictional resistance to motion."

5—Adam, N. K., "Molecular forces in friction and boundary lubrication," Inst. Mech. Engrs., Lubrication discussion, London, 2, 200-1 (1937).

crystal is indicated by the following paragraph. He says,

> "Graphite consists of plane sheets of carbon atoms, of indefinite and large extent, exceedingly tightly linked together in the sheets; each sheet is, however, rather loosely attached to the next sheet parallel to it, and sliding or separation can easily take place. It is known, from studies of electron diffraction, that graphite is easily attached to metal surfaces, these sheets being parallel to the surface; the sheets afford protection against seizure between the metals. When real contact occurs, it will be between the outside of the sheets of graphite and not between the metals. When separation occurs, graphite is the weakest link in the bridge, and breakage occurs in the graphite and not in the metal."

THE CAST iron from which the motor blocks of internal combustion engines are made, is especially rich in free graphite. By means of a special instrument known as the electron diffraction camera, surfaces of this type may be examined. Electron diffraction methods differ from X-ray procedures in that electrons are poor in penetrating power and hence are, by necessity, confined to surface explorations[6]. This method has been employed to prove the existence of graphoid surfaces on friction parts which have been consistently lubricated with oil containing colloidal graphite. It is found that when iron is subjected to a rubbing action the graphite flakes are spread over the surface to provide a film possessing low friction properties.

Failure of Ordinary Lubricants

The high temperatures encountered in many present-day industrial processes have emphasized the need for suitable lubricants which, while performing their appointed function satisfactorily, must, in addition be clean and odorless as well as economical in service. The conventional lubricants designed for use under conditions of high temperature, have usually been either heavy greases or high viscosity oils, the greases having been produced by thickening petroleum bodies with metallic soaps. Such products, however, are unable to withstand the extremely high temperatures which often exist in many industrial operations. Oils, when subjected to severe heat, decompose or distill off, and greases are consumed leaving behind a residue of non-lubricating soap.

OBVIOUSLY, then, a lubricant which will perform satisfactorily under these severe conditions must possess unusual properties. First, and most important, it must remain wholly unaffected by heat, i. e., resist oxidation. Second, it must retain its lubricating properties when subjected to heavy pressures, and finally, not be removed from the metal surface by the sliding movement of parts to which it is applied.

Electric-furnace graphite, colloidally dispersed in a suitable carrier fluid, adequately meets these requirements. When applied to baking and enameling ovens, furnace and kiln cars, glass-making machinery, and similar devices, subjected to high temperatures, this class of lubricant produces on friction surfaces, a tenaciously adsorbed graphite film which resists oxidation, discourages corrosion, eliminates sticking, and affords positive mechanical action with a minimum of friction. This would not be true of the ordinary type of lubricant.

Moreover, oils and greases when used to lubricate mechanical devices operating at high temperatures sometimes fall short in that they either distill off or decompose. However, when a low carbon petroleum product or even a special carrier such as water is used as a dispersion medium for colloidal graphite, a unique type of high temperature lubricant results.

It is readily recognized therefore, that until the advent of colloidal graphite, there was no lubricant available for machinery parts that was suitable for use above what might be termed ordinary temperatures. Consequently, machine operation at high speed was virtually an impossibility.

6—For a review of electron diffraction research, of. Clark, G. L. and Wolthuis, E., "A resume of electron diffraction," J. Chem. Educ., 15, 64-75, (1938).

Fluid Carriers Available

THE TYPE of fluid carrier which most conviently assures these results varies with the problem at hand. Wherever petroleum fluids are adapted to conditions, colloidal graphite dispersed in such liquids, mineral spirits, spindle oil, etc., may be employed. Colloidal[7] graphite can likewise be dispersed in the more viscous of petroleum fluids. Where conditions are such that the lubricant is applied to a cool surface (below 100°C.) colloidal graphite in water is used with good results.

Colloidal graphite dispersions designed for use as lubricating agents, are designed by the general term "Dag," a trademark name. If the carrier fluid is oil in character, the dispersion is termed "Oildag," whereas, if the solid phase is dispersed in water, the resulting dispersion is indicated by the name "Aquadag." A description of the dispersions best suited for the majority of high temperature applications follows:

(a) *Oil dispersion*, "Oildag" Concentrated (approximately 10% by weight colloidal graphite in petroleum oil). This material is used for blending with petroleum fluids to the desired graphite content.

(b) *Water dispersion*, "Aquadag" (approximately 22% by weight colloidal graphite in water) for blending with distilled water.

(c) *Mineral spirits dispersion*, "Dag" Colloidal Graphite, Dispersion Series Type 2400 (in mineral spirits) for blending with petroleum fluids.

Until recently the formation of stable suspensions of colloidal graphite in extremely low viscosity liquids, such as: benzol, carbon tetrachloride, trichlorethylene, triethanolamine etc., could not be accomplished. However, improved processes have now made it possible to commercially produce highly stable preparations of colloidal graphite in a wide variety of carriers. No longer does the addition of organic penetrants to petroleum compounds introduce the problem of maintaining graphite suspension.

COLLOIDAL graphite can be suspended in carriers other than mineral oil. When diffused in a mixture of glycerine and water, colloidal graphite completes a combination which is employed for the treatment of rubber components contained in shackles, shock absorber arms, steering columns, axle spring seats, motor mountings, etc. Glycerine, being hygroscopic prevents evaporation of the aqueous constituent lowers the freezing point of the mixture and contributes to increased viscosity. Most important it has no deleterious effect upon rubber. The merits of water as a rubber lubricant are sufficiently well known to require no extended comment here and colloidal graphite, of course, reaches remote parts by penetration as effectively as when incorporated in penetrating oils.

Mechanism of Graphite Lubrication

The chief advantage of colloidal-graphited oils and greases lies primarily in their ability to establish films of adsorbed graphite upon the friction surfaces of mechanical devices. These graphoid surfaces as they are called, act to satisfy the surface energy of the metal or other material to which the lubricant may be applied. Such graphite films are closely bonded to metallic and other bodies by physico-chemical forces and produce a combination similar to an amalgam.

MOREOVER, graphoid surfaces possess a very low coefficient of friction. Because of the low interfacial tension existing between oil and graphite, oil wets graphoid surfaces more freely than those of plain metal. This factor contributes to the prevention of oil film rupture. These surfaces also retain in a large measure the properties of the graphite from which they are formed and consequently are able to serve in an emergency as dry lubricants. It is also interesting to note that the value of a plain mineral oil as a lubricant under heavy loads diminishes rapidly above a certain critical temperature[8]. It has been found that the addition

7—In the broadest sense colloids are "that form of matter which is in the 'twilight zone' between coarse suspensions and substances in true solution."

8—Critical Temperature—refers to that temperature above which the value of a straight mineral oil as a lubricant diminishes rapidly when operating under a heavy load.

of a small percentage of colloidal graphite raises this temperature 10°C. to 20°C.

Acid-free oils having low viscosity and good penetrating lower are useful carriers for lubricating remote and closely fitting parts. If such oils contain colloidal graphite and are used consistently, they form on friction parts adsorbed graphoid surfaces, with great tenacity. These layers are unaffected by solvents, and furthermore, the microscopic particles pass without difficulty through the smallest of crevices and experience no filtering actions which result with even the finest of graphite powders. Experience has shown that the colloidal graphite content should be approximately 0.2% to 0.4% by weight.

Unlike ordinary fluid lubricants which decompose under the high temperatures that exist in the upper cylinder zones of internal combustion engines, electric-furnace graphite colloidalized and incorporated in top cylinder lubricants forms mirror-like, heat-resisting self-lubricating surfaces on cylinder walls and valve parts. After the oil carrier has been destroyed by the high temperatures of combustion, the inert graphitic film continues to function as an anti-friction surface on the valve mechanism and those engine parts located directly in the combustion zone.

COLLOIDAL graphite improves the lubricating qualities of greases just as it increases the efficiency of plain oils—by forming on friction parts tenaciously adsorbed graphoid surfaces as described in the foregoing. Colloidal-graphited greases, in addition to providing improved lubrication, have other advantages. When a bearing is lubricated with grease, a certain amount of lubricant is consumed. With greases containing *ordinary* pulverized graphite, the latter is not always consumed at the same rate, as the medium in which it is applied with the result that the graphite tends to accumulate. Greases containing colloidal graphite are quite free from the tendency shown by ordinary graphite. Furthermore, since the particles of graphite are in the colloidal state and are consequently of extremely small mass, they are unaffected by the centrifugal force created in high-speed wheel bearings.

Graphite films formed on metals with "dag" colloidal graphite are used primarily for their unctuous and lubricating properties. This performance may be summarized in the following statements:

(1) Colloidal graphite in oil forms a "graphoid" layer on friction surfaces which discourages the sticking and seizure of mechanical parts.

(2) Graphoid surfaces provide efficient dry lubrication for extended periods in the absence of oil.

(3) A graphoid surface is more easily wetter than a plain one (i. e., it has a lower interfacial tension with oil) and, being difficult to wipe clean, retards oil film rupture.

(4) The addition of colloidal graphite to an oil raises its critical temperature 10°C. to 20°C. (18°F. to 36°F.)

(5) Colloidal graphite is inert and, therefore, will not combine chemically with any liquids, solids, or gases with which it may come in contact.

(6) Graphite remains unaffected at normal temperatures, requiring approximately 600°C. before carbon dioxide results from its combination with oxygen.

(7) Graphite particles are sufficiently fine to pass through carburetor jets and penetrate any interstices into which their carrier is capable of entering.

(8) Colloidal graphite in an oil does not induce sludge formation.

(9) Colloidal graphite, within the limits of recommended use (i. e., 0.2% by weight), does not increase the viscosity of an oil.

(10) Colloidal graphite lubricants effect 40% to 50% less wear of cylinders and piston rings than a plain oil.

Literature Cited

From the foregoing, it can be readily seen that colloidal graphite plays a most vital and important role in the safe operation of machinery at high speed. Were it not for lubricants containing colloidalized graphite, our present war production effort would be seriously handicapped. The ever increasing de-

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A Pendulum Demonstration

M. J. W. PHILLIPS

West Allis High School — West Allis, Wisconsin

WHEN THE subject of the pendulum is taken up in high school physics, the pupil is left with the impression that all pendulums of the same length have equal periods of vibration. This is true of the simple pendulum only. Fewer than half of the elementary physics texts discuss "center of oscillation" or "center of percussion." This demonstration offers the teacher of physics an opportunity to raise interesting questions concerning these phenomena, as well as to give the class additional work with the mathematics of the pendulum.

The appartus is easily made by a pupil at small cost from easily obtainable materials. Figure I., the drawing, and Figure III., the photograph, show the equipment. The frame consists of two uprights made of one inch dowel rod, glued into two pieces of 2x4 at the bottom to serve as a firm base. At the top these dowel rods are glued into strip of wood 1x2 inches and $3\frac{1}{2}$ feet long. The width of this frame supports five pendulums all one meter in length. In Figure I., pendulum No. 1 is a simple pendulum made of a brass ball and a thin thread supported by a piece of $\frac{1}{4}$ inch wooden curtain pole. This is obtained from any lumber yard. Two eight foot lengths of this material are needed. Cut the pole into 42 inch lengths in order to have the resulting pendulums of sufficent length that they may be trimmed down to exactly one meter. Pendulum No. 2 is a plain piece of $1\frac{1}{4}$ inch curtain pole. Pendulum No. 3 is the same except it is trimmed or turned so as to taper from the center toward both ends. Pendulums No. 4 and No. 5 are tapered toward one end as shown.

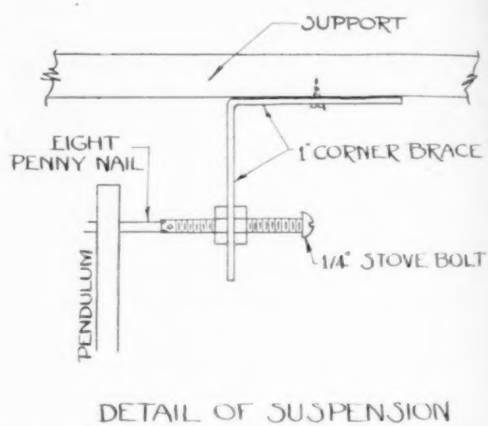
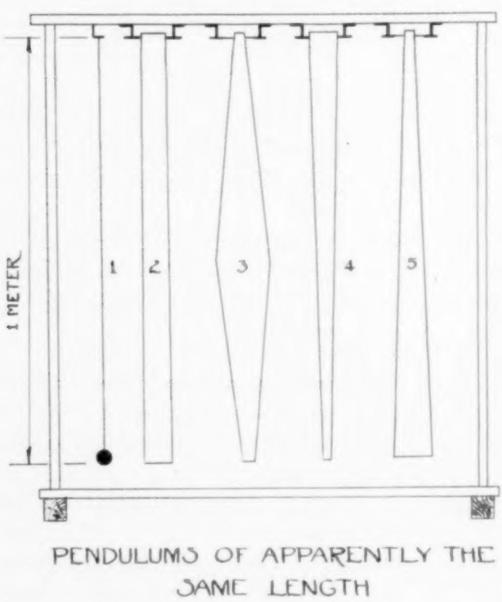
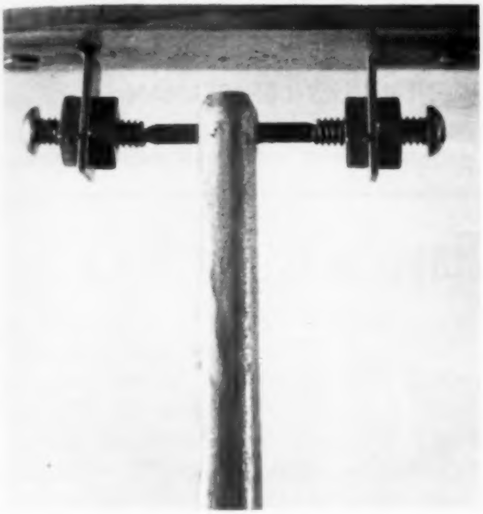


Fig. 2. Detail drawing of suspension of the pendulum.

Fig. 1. Pendulums of the same length.



THE SUSPENSIONS are made from one inch corner braces obtainable on the hardware counter of any dime store or hardware store. These braces are drilled with $\frac{1}{4}$ inch holes, through which are placed $1x\frac{1}{4}$ inch stove bolts fitted with two nuts, one on each side of the brace. This is shown in detail, Figure II. and Figure IV. The stove bolt ends should be drilled slightly on the ends. This is done with a 7/32 inch drill. Place one nut on the stove bolt with two threads of the bolt showing above the nut: on these threads fasten securely another nut.fl This serves to easily center the drill onto the bolt end. Through the end of each pendulum put a common eightpenny nail of suitable length which has been



sharpened to a point on both ends. These sharpened ends fit into the drilled ends of the stove bolts. This device offers little friction and the pendulums will swing in the same plane.

Since all the pendulums have been cut longer that a meter, they are now carefully trimmed on each end until the distance from the point of suspension to the lower end of the pendulum is exactly one meter. The whole equipment is then assembled and adjusted for the least friction. The nuts on the outside of the suspension may then be tightened with a wrench and will be very rigid.

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Fig. 4, Above: Photograph showing in some detail the suspension of pendulum

Fig. 3, Right: Determining the time of one swing of each pendulum.

EDITED BY JOSEPH SINGERMAN

• A department in which science is presented in its close relationship to the individual and in which guidance is given in causing the individual to recognize the methods of science and its vast social implications.

Hysteria vs. Happiness

WHILE thoughts for this writing were revolving in my mind, I happened to read in a newspaper editorial a reference to mental ailments among inductees and in the armed forces. It is said that psychological casualties resulting from military action are far more numerous than the number wounded. I do not find this revelation alarming because I recall having been told some years ago, by an eminent psychologist, that some twenty percent of our population harbors potential mental instability of a nature which may eventually require institutional treatment. I do not pretend to be able to discuss this topic as a psychologist. In that field I am little more than a layman. But I do have a deep social consciousness with a background of scientific training. With those qualifications, or limitations if you will, I do approach this subject.

My thoughts on this topic find a base in an experiment reported to the Convention of the American Association for the Advancement of Science, five years ago last December. The report was embodied in a paper presented by Dr. R. F. Maier, then Assistant Professor of Psychology at the University of Michigan. I was struck immediately with the possible human social implications of Maier's experiment with rates, although he himself carefully avoided speculation. This is not meant as a criticism of Dr. Maier. It stands rather to his credit that he reported accurately the factual results of the experiment. Maier's report, I was convinced, represented a milestone in experimental phychology.

MAIER'S rat was confronted with two screens, one showing a white circle on a black background; the other a white background with a black circle. The rat had to choose between the two. If he jumped through one screen he was rewarded with food. This we shall call the positive screen. Jumping through the negative screen would cause the rat to find himself caught in a net, presumably an unpleasant experience. The rat happily learned to make the desirable choice. Then Maier confronted his rat only with the negative screen, and prodded him with an unpleasant blast of compressed air. Forced to act in a new way or remain in an unpleasant situation in which there was no escape from the unpleasantness, the animal developed tension. One rat leaped out of the side of the apparatus. Another jumped upward. They developed ticks and other signs of nervousness. I say the rats were hysterical. Dr. Maier concluded that the animals had developed a genuine neurosis by purely phychological methods; and that the hysteria was due to a necessity to act in a critical situation in which no satisfactory action seemed to be available.

The person who suddenly awakens to find himself confronted by a conflagration in his home, may be deemed to be in a predicament similar to that of Maier's unhappy rat. He is forced to act in a new way, or remain in an unsatisfactory situation in which there is no escape. If a satisfactory mode of behaviour is not known or available in this embarrassing circumstance, this person will become hysterical. Maier cured his rat of hysteria by returning him to the normal environment with positive and negative screens. But that solution is not possible immediately for the person whose house is on fire. I imagine that those decent people who were so unfortunate as to find themselves trapped behind the onrushing hordes of Fascist troops, in the darkest phase of the present war, experi-

enced a psychological catastrophe of a similar nature. They require sympathetic phychological treatment as they are liberated. The exception to this of course are those who found a satisfactory mode of action in organized guerrilla warfare.

I tell my students of Maier's experiment when I teach them fire fighting or first aid. I suppose it would be appropriate too when teaching conditioned reflexes. "Can we teach a person," I ask, "a number of things he may do in the event he is confronted by an emergency situation, such as the burning home?" Of course, we can teach him, in advance, practical methods of fighting a fire, means for summoning assistance, to crawl along the floor if it becomes necessary to avoid smoke, not to jump from a window if he can wait for a rescue ladder, and so on. In fact, the human intelligence makes it possible to learn in general to be calm in an emergency and think out a solution. This person will not become hysterical in such a situation because he is provided with a satisfying mode of behaviour, an emotional outlet if you will. He has been taught or trained to do certain things to solve the emergency problem. I presume Maier's rats could have avoided their neurosis if they had been taught how to shut off the compressed air, or to torment the experimenter who dared thus to disturb them.

THIS TAKES me back to the soldier. Considering the high potential of psychoneroses among our population, it is remarkable that there is not a far greater incidence of mental casualties in the armed forces. That is due in large measure to pre-education, which we call training. The soldier learns how to act and resolve various battle situations in sham maneuvers and actions. Military men have learned the importance of training, without benefit of learned psychologists, but through actual experience; though psychologists now help them to weed out in advance those for whom ordinary training will not suffice.

Last May, Lieutenant Commander Erwin R. Smith of the Naval Hospital at Mare Island, California, described to the American Psychiatric Association an example of war neurosis which afflicted many Americans who fought so valiantly at Guadalcanal. The Japs concentrated their activities so as to torment the Americans during the night, knowing that the Americans had been accustomed to rest in that period. "All of them," he reported, "in their composite story, gave a picture of physical and mental strain that combined the best of Edgar Allen Poe and Buck Rogers . . . The end result was . . . a disturbance of the whole organism, a disorder of thinking and living, of even wanting to live." It is certain that our soldiers are now being trained, before going into battle, to contend with this type of situation too.

ONE CAN hardly contemplate this experience without visualizing a sharp contrast with the small incidence of psychiatric casualties among the men, women and children, defenders of Sevastopol, or among the untrained and poorly equipped volunteers in the International Brigade, fighting the Loyalists cause against great odds on the side of Fascism, some six years ago in Spain. This brings me back to the newspaper editorial to which I alluded at the beginning of this article. (Max Lerner, in *PM*, December 30, 1943.) "The best answer I have heard," writes Mr. Lerner, "is that the army must embark on a program which will develop the will to fight, and that this in turn means army education that will teach the men what the war is about, what its purposes and stakes are." Then, Lerner clinches the point when he adds, "I am told that it can be pretty well proved statistically that where training camps have had good orientation programs, there have been fewer breakdowns and less malingering." The Sevastopol defenders and the Loyalist volunteers knew what the war was about, what its purposes and stakes were. They were fighting for freedom and against Fascism. They understood the threat of hated Fascism. The battle provided them with a satisfactory mode of behaviour.

I believe implications drawn from Maier's famous experiment may play an important role in helping to understand many everyday experiences. The adolescent youngster burdened with a real or imaginary grievance, finds himself in a situation which requires

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Importance of Insects in War Time

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THE FOURTH great phase of insect injury to our welfare and interests, which is of great significance at all times, but of *vital importance* in these crucial times, is the damage that these six-footed pests do to growing crops.

Here, as in their attacks upon our bodies, upon our domestic animals, and upon practically all of our stored products, the motivating factor is largely hunger, and most of the damage is caused by the feeding of the insects.

No crop, or plant that grows is entirely free from damage by insects, and, in general, our most precious food- and fiber-crops are the most severely injured. It appears that we have about as good judgment as the insects! And the crops we find to be most essential to our existence are the ones most craved by bugs.

In crucial times like the present, when we are all being urged, *and are anxious* to produce the greatest possible amount of life's essential materials, the significance of preventing insect damage will be impressed upon us all, as never before.

VICTORY gardeners, as well as those who devote *all* of their time and resources to crop production, will be advised repeatedly to give attention to the importance of careful preparation of the soil; the selection of good seed and varieties adapted to their particular locality; proper cultivating; adequate watering; and essential fertilizing. These basic procedures may be called "the *positive* factors of crop production." But too often growers are inadequately informed or concerned about the *negative factors of crop production*, such as the control of destructive insects, and the prevention of plant diseases.

Any one who neglects these negative factors of crop production is surely headed for disappointment and failure of his gardening efforts. Dr. L. O. Howard, distinguished former Chief of the U. S. Bureau of Entomology, stated the situation very graphically when he said: "American insects continually nullify the labor of one million men." That is to say, the amount of food and other crops destroyed by insects, every year in this country, is as much as a million laborers, devoting all of their energy to the jobs, can produce.

THERE are a half dozen very important methods of injury or distinct ways in which insect pests destroy our growing crops, if they are not carefully controlled. First, there are the Chewing Insects, which cut off with their jaws and swallow portions of leaves, buds, flowers, fruits or stems, leaving visible ragged holes, or if very abundant, they may leave nothing but the toughest parts of the stems. Familiar examples of these chewing insects are: grasshoppers, potato beetles, striped cucumber beetle, Mexican bean beetle, flea beetles, blister beetles, cabbage-worms, tomato hornworms, asparagus beetles, and many related kinds.

The second major method of injury is by the Piercing-sucking Insects. These are "drinkers" instead of "chewers." They attack all parts of all kinds of plants, much as mosquitoes or bed bugs attack us— punching minute, microscopic holes into leaves, stems, buds or fruits and sucking out only the sap. Their mouth stylets are so slender that the holes they make are seldom seen; but the withdrawal of the sap causes pale, white, yellow, brown or red spots; curled leaves; withering stems; deformed or fallen fruits; or a general wilting, browning and dying of entire plants. The commonest insects of this type are the aphids or plant-lice, the scale insects, the squash bug, tarnished plant bug, chinch bug, leafhoppers, thrips and red spidermites. The beet leafhopper, which causes the deadly curly-top disease of sugarbeets, is more aggravating now than ever before, because of its ability to add greatly to our sugar shortage.

THE THIRD principle method of injury to growing crops is by the Internal Feeders,

including borers in stems, buds and fruits; leaf-miners; gall makers; and weevils in seeds. These are chewing insects, like the first group; but instead of feeding on the outside of the plants, they eat holes in plants big enough to crawl into and thus make their feeding serve two purposes: (a) nutrition from the tender, succulent, clean, internal tissues; and (b) the formation of a kind of "bomb shelter," hiding place, tunnel or burrow, which protects them from many dangers and makes it harder for man to destroy them. Since they either hatch from eggs thrust into the tissues by the sharp ovipositor of the female, or eat in when very small, their tiny entrance holes are generally not noticed; and only when they push out the frass from their living, upon the surface of the plant; or when the entire plant begins to wither, die or break over; or the infested fruits drop to the ground; are we apt to realize their presence. Large holes in stems, logs, seeds or fruits are nearly always the exit or escape holes; and by the time we see them the damage has been done, the pest has escaped, and it is too late for control measures to save that crop. Among the most destricutive borers and weevils in this area are the recently invading European corn borer, which is now distributed over all but the southern 5 or 10 per cent of Illinois. It has not yet become abundant enough in this state to cause severe losses, but if we should have a series of wet summers, like 1942, and if farmers do not plow under all remnants of the corn crop or rake them together and burn them before early spring, it will likely become the most destructive insect in the state, ruining sweet corn, field corn and many vegetables and ornamental crops. Other very troublesome internal feeders include the corn ear worm, the peach porer, apple and shade tree borers, the squash-vine borer, the common stalk borer, pea weevil, bean weevils, wheat jointworm, shot-hole borer and other bark beetles.

AS DEADLY to growing plants and even more difficult to control are the many kinds of Subterranean Insects, which crawl about underground and feed upon, chew off, suck sap from, or tunnel into, the roots, tubers or underground portion of stems and sometimes eat out the contents of planted seeds before they have grown up to the surface of the ground. In this troublesome group are the white grubs or grubworms, the wireworms, the cutworms, some of which come out of the soil at night and eat off the stems of small seedlings or newly-transplanted plants and are unusually destructive because they eat only a small part of the plants they cut off and then seek others to ruin them in the same wasteful manner. Other very destructive subterranean pests include the seed corn maggot, cabbage root maggot, corn root aphid, grape colaspis, clover root weevil, striped cucumber beetle, corn rootworms, the larvae of flea beetles and of the notorious Japanese beetle. The Japanese beetle is another recent invader of Illinois, already established about Chicago and East St. Louis; and, if they are as successful in invading and holding territory here in Illinois as the Jap soldiers have been in the East Indies and Burma, we shall soon all have to fight these destructive Jap. Beetles, to save the grass in our lawns, parks and golf courses, which the larvae or grub stage destroys; and to save our garden vegetables, flowers, fruits, shade trees and ornamental shrubs, and our soybean and corn crops, all of which are attacked by the chewing beetle stage.

Finally, and most-destructive of all the insect enemies of growing crops, are the disease carriers. They not only damage the plants by their direct attack, but, while doing that, they transmit to the plants the germs or pathogens of many plant diseases. They are as deadly to plants as the malarial mosquitoes, or typhus-infested lice, or plague-carrying fleas are to the lives of men, and in the same way. It is much like the bite of a mad dog. The bite itself may be serious; but if the dog's teeth are contaminated with the virus of hydrophobia, the death of the bitten victim is likely to follow the attack. Such "mad-dogs" among the plant-eating insects include the striped cucumber beetle, which spreads the devastating cucurbit-wilt disease from plant to plant and garden to garden; flea beetles which disseminate the early blight of potatoes and the bacterial wilt of corn, called Stewart's disease; aphids, which carry a variety of mosaic diseases, affecting many garden and field crops;

leafhoppers, which spread destructive viruses among sugarbeets, peaches, cranberries, corn, rice and other food plants; the bark beetles which have caused the death of millions of elm trees, by spreading the Dutch elm disease; to mention only a few of the known plant-disease carriers.

THERE is obviously not time to discuss the control of even the most important of the crop-destroying insects, individually. I regret this, because the most important thing to do, when in insect outbreak confronts us, is to determine precisely what kind of insect it is. Insects are so varied in habits that one can never predict, from the known control of one species, what will be effective for another kind. They are so individualistic that a control measure for one kind is often useless for another, closely related species whose attack is similar. And entomologists have studied the destructive pests so intensively that they have discovered special, specific control measures, particularly effective for nearly every kind.

Nevertheless there are certain basic principles of control that should be clearly understood by all of us, so that we shall not be applying Paris green to our cabbage or pea plants to kill the plant lice on them, dusting melon plants with air-slaked lime for melon bugs, wasting lead arsenate by adding it to grasshopper baits, or spraying cabbage plants with lime-sulphur to kill cabbageworms.

FIRST, we should understand that the outside of the bodies of all insects is covered with a remarkably protective shell or body wall. Insects have no internal bones, but have their skeletons on the outside of the body and composed of a remarkable substance that has the protective qualities of steel, leather and rubber combined. Their body walls are not only shatter-proof as the new synthetic plastics; and as rust-proof as stainless steel; but also resistant to practically all know chemicals. Consequently we must use very-carefully-tested chemicals to kill them and we must get these chemicals *into the inside of the body of the insects* or they will have no effect. Fortunately there are two gaps in the insect's protective armour—two vulnerable points through which sprays and dusts can pass to kill them: the insect's mouth which we may think of as the insect's front door; and the ventilating windows, spiracles or breathing holes, along each side of the body, through which most insects breathe. Now the front doors of the crop-destroying insects are guarded by two very different kinds of "gates," designated as different kinds of mouth parts: *chewing mouth parts* and *piercing-sucking mouth parts.* The gate with the chewing mouth parts is easily penetrated: the doors swing wide as these insects feed, and it is an easy matter to get insect poisons, sprayed uniformly over the parts of the plant which that particular insect eats through to the insect's stomach, where, if we have used the right kind of poison, it will quickly kill the pests. Such insecticides, which must be swallowed to be effective we call *stomach poisons.*

The piercing-sucking mouth parts, on the other hand, are like a secret passage to a pirate's den, carefully closed to the entrance of everything except the clean sap, freshly sucked from inside the plant leaf, stem, bud or fruit. Spreading poisons upon the surface of plants is of no use for killing these sap-sucking insects. They will thrust their very slender, sharp, needle-like stylets through the layer of poison and draw sap from inside the plant without swallowing any of the poison on the surface of the plant.

THE FIRST key to insect control, therefore, is to note what kind of mouth parts the particular pest has. We can usually tell this without even seeing the insect: If damage is being done by chewing insects, the plants will show definite holes in leaves, buds, fruits or stems. If the damage is being done by piercing-sucking insects, the plants will not show any visible holes, but the leaves will be curled or distorted, white-spotted, brown or yellow, wilted and dying.

We must therefore remember that stomach poison insecticides are generally effective for chewing insects, but will have no effect upon sap-sucking insects, such as aphids, leafhoppers, scale insects, squash bugs, tarnished plant bugs and related kinds.

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An Educational Films Program in the East St. Louis Senior High School, East St. Louis, Illinois

J. W. GALBREATH*

East St. Louis Senior High School East St. Louis, Illinois

I. Introduction

AUDIO-VISUAL education in the East St. Louis Senior High Schol has had a gradual development from its beginning in the spring semester of 1939.

When it appeared that the money for purchasing equipment was forthcoming, several leading makers of audio-visual equipment were asked for demonstrations. They cooperated most patiently. We finally agreed on the equipment that most nearly met our needs. This equipment consisted of one projector, which would answer a dual purpose, for projection and amplification in the classroom and auditorium. Two twelve inch dynamic speakers were placed at different positions at the front of the auditorium in an attempt to overcome poor acoustic conditions. They were found to do the best job when they were raised about ten feet above the floor to the right and left of the stage. The sound is not yet perfect for a thousand students, but it meets general requirements very satisfactorily.

AT FIRST, we had just a crystal microphone with stand, then later two additional crystal microphones with a three-way attachment were added. Later a phonograph-record reproducer was purchased which made our equipment rather complete. To connect up this equipment we used one-hundred and fifty feet of speaker cord and one-hundred feet of power extension cord. This made it possible to place the projector in the back of the auditorium with a throw of about seventy-five feet to a nine by twelve beaded screen, which rolls up when not in use.

II. Objectives

The general objective as stated in our first general bulletin put out by the Visual Education Committee was stated as follows: "The motion picture derives its educational effectiveness not from what it is, but from what it can do. What it does may either be largely informatory, largely stimulative or largely clarifying."

THE SPECIFIC objective for each individual film was pointed out and an attempt was made to educate key teachers in the proper use of educational films rather than using moving pictures for a "show." This education has consisted of demonstration, reading material, and actual use or experience.

The specific objectives are:

1. To initiate the subject: as a preview or introduction to the unit of subject matter to be studied.
2. To enrich the subject: as a motivating device to stimulate new interest in the subject matter.
3. As a substitute experience: to take the place of field excursions and visits to industrial plants.
4. As a direct teaching aid: to establish concepts of a unit of subject matter.
5. As a review: to summarize and review the unit.

III. Subject Matter Correlations

Each film was fitted into the subject matter by long range planning, as closely as possible, to meet these objectives. Each teacher using the films was urged to instruct herself, by teacher's manual and by preview, as to the content of the film. The teacher in turn instructed the pupils in what to expect and watch for in the picture.

The films in other words were taught *before, during and after* presentation. Tests on the films were encouraged, and the fact has been established that students can be taught to see a film in the correct perspective.

IV. In Operation

1. The same director has been in charge of the program since its beginning. A new visual education committee is appointed each year

*Mr. Galbreath is director of visual education in the East St. Louis Senior High School.

by the Principal. The director of visual education is chairman. Members are selected from each department and the personnel changes each year. The purpose of this is to educate others in the techniques of the pro-program and to cause them to become more sympathetic and to have a better understanding of the program.

EACH DEPARTMENT is thus represented on the committee and has a "go between" for the director and the department. Each member is responsible to his department for the requisition of films to be used, for arranging the schedule for showing the films, notifying teachers and making arrangements for any class changes that are necessary. Complete reports on films are sent to the director immediately after a showing.

2. Booking of Films. The films for each department are booked as a unit by the department committee member on a form provided for that purpose. This form includes such data as: title, length, type, source, rental cost, and date requested. In as far as possible each department has a certain day on which to use films, thus: all physics and chemistry films are on Mondays, biology and home economics on Tuesday and Wednesday, shop and social science on Thursday, etc. This systematizes the schedule to some extent. Of course, chemistry films are not shown every Monday, but will alternate with physics, and so it is with other departments. As far as possible rented films are secured from a single source, usually in a block booking, at least a semester in advance. About 47% of these are secured from the University of Illinois rental library at Champaign, Illinois; about 5% from Y.M.C.A., Chicago, Illinois; 13% from State Department of Public Health, Springfield, Illinois; 22% from Bureau of Mines, Pittsburgh, Pennsylvania; and the rest, 21%, from other sources.

3. A calendar which lists each school day, is made up in advance, and the films are entered as bookings are received. In the procedure, there is not much chance for confusion, and very few films have to be canceled or rebooked.

V. Operators

OPERATORS are selected, trained, and passed on by the director. As a rule much care is used in their selection. They are boys who do not have many extra-curricular activities because an operator's job is a full time one. These boys are appointed for one semester, and if they do not prove up to certain standards they are dropped. As a reward for their services, these boys receive passes to auditorium pay-programs, athletic contests, etc. An attempt is made to sell them on the idea that many services and courtesies rendered in the home, in the school, and in life, are not paid for in money but in the satisfaction of doing a good job while gaining valuable training.

Each operator is supplied with the following "Rules" and is expected, if he becomes a good operator, to live up to these requirements.

THE PROJECTOR OPERATORS' CLUB

For Operators Only

I. General Instructions:

1. Two opreators will be assigned to 116 for each hour. They will work alternate weeks. Get a library pass from me to go to the library when not operating.
2. Check the bulletin board each week and each day for directions.
3. Do not rewind the films after the last showing and return the same to me in 116. See that the cover bands are around the proper films and that the right film is in the correct can.
4. All operators read the "Manual of Instruction."

II. Qualifications

1. To be an operator you must keep up in your school work; an average of G is required.
2. Always be courteous to the teachers. *Do not argue.* Remember you are rendering a valuable service to your school, and receiving worthwhile training for yourself.
3. Above all tend strictly to business. Remember that you have a responsible job with expensive equipment.
4. There are two grades of operators: Junior—and—Senior.

A junior operator must meet the requirements as given in these instructions.

A Senior operator must have had at least one semester's experience and have passed the "Operator Proficiency Test." He is then awarded the "Certificate of Proficiency."

III. Officers and their Duties:

1. Chief Operator—Shall be a Senior Operator. Their duties shall be to instruct new operators. Check equipment. Assist the Visual Education Director wherever possible.
2. Assistant Chief Operator—Shall be Senior Operators. Their duties shall be to assign operators for the week and for each period every day. To

keep records as directed. To assist the Chief wherever possible.

3. The officers of the "Projector Operators' Club" shall be elected by the operators and shall hold office for one semester or until new officers are elected.

IV. Setting up the Projector:

1. Keep cords straight, and out of the way as much as possible.

2. Place the speaker on a solid base.

3. Oil the machine first, clean the lenses and everything that comes in contact with the film, aperature, film-gate and sprockets. Use special care in cleaning the film-gate as this is where the dirt and dust show up on the screen. Check by turning on the lamp, so as to show on the screen, before threading.

V. Threading:

1. Use care in placing the film over the sprockets. Sprocket teeth if not properly meshed with sprocket holes in the films, will punch holes in it.

2. A one inch loop must be left both above and below the aperture or "gate." A good test for threading is to turn the mechanism by hand before starting the projector.

3. If sound films, turn the amplifier on before threading, this gives the tubes time to heat up before projection is started.

4. Run the leader through to the title. Center the film on the screen and bring the title into sharp focus.

VI. Operation:

1. Adjust the volume and tone control as required by the conditions of the room and by nature of the film.

2. A good operator will familiarize himself with the sound of his projector. Unusual sounds warn the alert operator that the projector may be damaging film. The noise accompanying serious damage is usually audible and sometimes very loud.

3. Feel the film lightly as it enters, and again as it leaves the projector. If the film is leaving the machine with rough tears or sprocket punches or torn sprocket holes, the machine should be stopped immediately until the cause of the damage is discovered and remedied.

4. Turn off the sound switch as soon as the end of the film is reached; also the lamp switch.

5. Turn off the pilot lamp as soon as the projector starts.

6. Always rewind the film after a showing except the last time it is shown. (Refer to the bulletin board for instructions.)

7. When disconnecting cords, take hold of the plugs and not the wire. This will aid in preventing loose connections and broken wires.

8. When leaving the machine after a film has been shown, turn off all controls and unplug your power line.

9. In taking down and storing equipment see that the cords are free from kinks and knots, and that all equipment is returned.

10. Don't let anyone fool with the machine.

11. The last operator in a day's run should see that the equipment is returned to the storage room without fail.

VII. Trouble Shooting

1. If projector does not run:
   (a) See if house outlet is plugged in.
   (b) See if machine plugs are connected.
2. If sound does not work:
   (a) See if speaker cords are plugged in at both ends.
   (b) See if microphone volume is turned completely off.
   (c) See if projector fuse is blown.

3. Be sure the take-up reel is not bent. Bent reels are sure to cause trouble. Stop the machine and straighten it.

4. Broken films should be rethreaded and run

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FILM PROGRAM

January 4-8

Teachers: Please write your name and the number of the room to be shown in each period

Operator		Hesse	Vonahue	Campbell	4—Jones 5—Rochards	Sondag	Luden	Title of Film
Period	Subject	1	2	1	4-5	6	7	
Monday	Physics	——	121	121	5-121	——	121	Electrons and Electro-dynamics
Tuesday	Home Ec.	25	25	——	4-25	——	——	Meat and Romance
Wednesday	Biology	116	114	17	5-116	114	17	Reactions in Plants and Animals
Thursday	Soc. Sc.	203	203	203	4-203	203	203	Working Knowledge of Nat'l Government
Friday	Auditorium	——	——	——	——	——	——	Politics and Civil Service

Science Clubs at Work

Edited by DR. ANNA A. SCHNIEB

State Teachers College | Richmond, Kentucky

• A department devoted to the recognition of the splendid work being done by the science club members and their sponsors in the various State Junior Academies of Science. Material for this department, such as student made projects; demonstrations and posters; outstanding club programs; state and regional meeting announcements; should be sent to Dr. Schnieb.

High School Victory Gardens

MARCIA GECKLER
Student President of Nature Study Club*

Arsenal Technical High School | Indianapolis, Indiana

THROUGH the Botany and Biology department, Arsenal Technical High School of Indianapolis has acquired several Victory Gardens. In the spring of 1943 the Botany and Biology classes, under the supervision of their teachers, were assigned plats approximately 24'x12'. In these plots the students prepared the ground, planted the seeds and sets, carefully checked growth, weeded, and cultivated the ground.

To start the gardens, the students first broke the soil with a hand plow and spades. Next the fertilizer was mixed into the neat top layers of earth. Then there was the job of "roping off" to be done when the pupils estimated the amount of space to be used in planting and that between the rows. After this was finished, the "farmers" used their trowels in ribbing the earth into rows where seeds were to be planted. Next came the consideration of how each seed should be placed in the earth and the amount of space to be left between each; this information was studied by the students before their gardens were laid out. After these preliminary steps the little seedlings were covered over for growth. This might seem the end of the work to be done, but it was merely the beginning. There was

(*Note: The club sponsor is Charlotte L. Grant.)

Left: A Victory Garden with each plot marked.

yet the watching to be done and the careful harvesting of the crop. There was always the possibility of early frost, at which time it would be necessary to cover the plants and keep them safe from freezing. Another tragedy that might occur were the deadly enemies who would threaten to eat all the leaves and other edible parts of the herbs. If this occurred, the farmers would have to spray or dust with poisonous powders to kill these pests. Occassionally rabbits were seen in the vicinity. Plant diseases were kept at a minimum.

SEEDS of carrots, onions, radishes, lettuce, peas, kale, swiss chard, mustard, corn, and bush beans were sown in the garden area. Onion sets were used as well as onion seeds. Tiny cabbages and tomatoes were grown under glass frames and later transferred to the out-of-doors.

An herb garden, tended by both the Botany and Home Economics Departments, occupied one side of the garden plot (shown by white stakes in the picture). Plants such as garlic, sage, dill, thyme, and parsley were grown.

Crops have been harvested by teachers and students. Several teachers canned beans, peas, and tomatoes. Throughout the summer, a produce market operated by the Agriculture Department sold vegetables to the public. These Agriculture gardens are more extensive and grow a greater number of crops than do the Biology and Botany Gardens.

THIS IS a lifetime story of one high school's Victory Gardens. This area has been enlarged to nearly three and one-half times the original size for the spring of 1944, and will again be farmed by high school science classes. Students derive pleasure as well as knowledge and experience in handling plants which may guide them to choose a life work or a very satisfying hobby.

Some Observations on Crows

PAUL CHUCALO
Biology Student
East. St. Louis Senior High School — East. St. Louis, Illinois

THE FOLLOWING is a summary of observations taken upon developing crows in a nest, their stages of growth, parental care given them by their parent crow, and a home experiment in raising crows.

I first observed the nest about the second week in April. The nest was in a tall elm tree, and was some thirty feet from the ground level. It was constructed on top of an abandoned squirrel nest and was built of rather large twigs and dead weeds. The twigs and weeds were interwoven to form a very strong, deep container.

At the bottom of the nest were five young crows. They were about two weeks old or less with their eyes yet unopened, and were covered with a soft, white fuzz. At this stage the crows were about the size of a month-old chick.

AT THE age of three weeks their eyes opened, and they unceasingly clamored for food. This food was supplied them by the parent crow. All day long she worked feeding the hungry crows. Camouflaging myself in vegetation near the tree while the parent crow was away, I spent some time with binoculars, observing what the parent crow brought in as food. In that period of time, the crow brought in one very young rabbit, two mice, and many, many grubworms. Two or three grubworms were brought in at a time. The rabbit was brought in laboriously from a nearby field by half carrying and dragging. This she dropped at the base of the tree, and with her powerful bill she tore out large pieces of flesh and carried them to the nest. On another occasion, I observed the crow to carry carrion from a dead hog on a nearby farm to the nest.

At the age of four weeks, the crows were almost completely feathered and required more food than ever. At this stage, I took three of

Continued on page 42

FUNDAMENTALS OF ELECTRICITY

Continued from page 9

ing with and maintaining magnetic and electro-magnetic devices.

Illustrative Activities

The following illustrate briefly the type of learning activities which may produce these results.

1. The life of the soldier may one day depend upon his ability to reach an objective and return by the use of maps and a magnetic compass. The effect of nearby iron or steel (cannon, tanks, etc.) on his compass reading must be understood and compensated for if he is to proceed accurately. The student may learn of this effect by taking a compass reading in a position some distance from magnetic substances, followed by other readings in various positions of proximity to such objects as room radiators or automobiles.
2. Compasses used in vehicles containing large amounts of iron and steel must be corrected for deviation. The student should recognize that compensation must periodically be checked in ships, bombers, and particularly in armored trucks and tanks where the constant jarring changes the magentic strength and modifies the polarity repeatedly. An automobile compass equipped with a compensator may be studied for construction and the method of adjustment. By taking readings first in the open, and then in automobiles of various types, the need for compensation will be made apparent. A follow-up check of such a compass should be made after it has been in use in an automobile for a period of two weeks or more to determine the need for recompensation.
3. Students should study maps of declination (isogonic) to observe the angle of magnetic variation at various places on the globe. They should practice taking bearings in their locality by reading a compass and correcting for the angle of declination at their position.
4. The teacher may prepare a map of a certain route in the community and allow the students to find an objective by use of unadjusted compensating compasses. Problems of compensation and delicnation will need to be solved for success in reaching the objective.
5. Study of induced magentism on precision instruments will be useful. The soldier who works near powerful electro-magnetics in line of duty should understand the danger of induced magnetism on such delicate mechanisms as watches. For a demonstration, a cheap watch may be demagnetized by placing it in a large solenoid through which an alternating current is passed. The alternation of the current produces a jumbling of the molecules of the watch metals. If the watch is then slowly removed from within the coil while the current is still flowing, the jumbling of the molecules will be maintained, thus demagnetizing the watch. The experiment may be repeated with the watch encased in, or surrounded by a soft iron shield. The student should understand the use of permeable substances such as iron in shielding precision instruments where they are used near powerful magnets. This demonstration should be preceded by simple experiments with magnets.

II. ELECTROSTATICS

IT IS important to the safety of men and equipment that the soldier appreciate the danger inherent in heavy charges of static (frictional) electricity. Such charges may be accumulated on vehicles used to carry and transfer gasoline and other highly volatile liquids. The student therefore should learn the phenomenon of the development of frictional charges, and should understand the principles involved in "grounding" such vehicles while in motion or while transferring gasoline. Another danger to be avoided—explosions sometimes result from the discharge of electricity borne by suspended particles of finely divided materials such as dust, flour, or gunpowder. Thus the student needs to appreciate the necessity of maintaining exhaust fans in rooms likely to be dangerously dust-filled.

Lightning is the evidence of discharge of static electricity carried by droplets of water in cloud formations. Military and civilian installations must provide for the dissipation

of these dangerous static charges. It is important that the individual understand the principles involved in the relative discharge of electricity from a point and from a rounded object, and be able to apply these principles to the problem of shielding himself and equipment from lightning.

INSTRUCTION in electrostatics may be designed to develop understanding of the above facts and of practical rules for lessening the danger of accumulating static charges. Furthermore, such instruction will provide basic understanding of principles which apply as well to current electricity.

Illustrative Activities

The demonstration of static electricity and discharge is difficult without the use of an electrostatic machine or an electrophorus. If an electrostatic machine is not available, an electrophorus can be made by pouring melted sealing wax into a small flat metal container such as a baking dish. A device to draw off the charge from the electrophorus can be made by cutting a disc of sheet metal, polishing off all rough edges and fitting it to an insulating handle attached to the center of the disc. A home-made or commercial Leyden jar can be used to store charges until a sufficient potential is secured for the discharge of a fat spark. In the suggested activities which follow, the electrophorus may be used wherever reference is made to a static machine.

1. Students may experiment with static discharge from their bodies. Shuffling the feet across a rug with a deep pile or across a heavy glass plate placed on the floor will soon generate a sufficient charge to produce a spark that may be felt, heard, and seen when the finger is used to ground the body. Discussion, experimentation, and the use of diagrams will aid in interpreting this phenomenon of the transfer of free electrons from one object to another through friction.
2. Lightning, and the danger of static discharge from suspended particles of metal, dust, gunpowder, smoke, etc., should be studied in relation to the building up of heavy charges, through friction resulting from the rubbing these particles against each other in the constantly moving air. A variety of experiments may be performed with the aid of an electrostatic machine and models of buildings, ammunition dumps, etc. The following are examples:
   a. Place a model metal building or a toy metal car on an insulating base and connect it to one terminal of the electrostatic machine or the outer coat of a charged Leyden jar. Use a metal plate to represent cloud formations; suspend this a short distance above the model and connect it to the other terminal of the electrostatic machine or to the knob of the Leyden jar. Demonstrate the discharge of lightning by bringing the suspended metal plate closer to the model until a charge is dissipated. Install "lightning rods" by placing thumb tacks on the top of the model. (Barbed wire is often used to protect military installations against lightning.) Again bring the suspended metal plate close to the model and observe the results.
   b. The effect of frictional static discharge in gasoline fumes may be illustrated by running insulated wires from the terminal of the electrostatic machine into a can fitted with a lid. Arrange terminal knobs at the end of the wires so that a spark is produced when the machine is operated. Place a teaspoonful or so of gasoline in the can, place the lid on the can, allow time for vaporization of the gasoline and operate the frictional machine. (There is no danger from this experiment if students are kept away from the top of the can.)

   The above experiments should be accompanied by reading and discussion concerning the phenomenon of static electricity as produced in rain droplets, dust particles, sloshing gasoline, etc. Proper safety precautions should be emphasized.
3. The consideration of static charges and of the theory may provide a basis for the study of condenser action and use. The

action of the Leyden jar (the original man-made condenser) should be discussed, A simple condenser may be made by attaching small metal plates to wooden insulating bases. One plate may be grounded to a water pipe. The other may be connected to an electroscope. The student should learn the principles of action of the condenser and the factors which determine condenser capacity.

4. Variable and fixed condensers may be secured from old radios, automobile, etc. Experiment with these by grounding one plate or set of plates and placing charges on the other plate or set of plates. On the variable condenser turn the dial so that the plates more fully oppose each other. Note the similarity of this action to the above experiment with the simple condenser as the plates slide opposite each other.

III. PRIMARY CELLS

MILITARY equipment depends greatly upon electric cells and batteries as sources of energy for motive power, light, and communications. Of the primary (non-renewable) cells, the dry cell merits special attention because of its wide use.

Most students will have had experience with dry cell in the operation of door bells, flashlights, or radios. They may have noted how careless handling has resulted in a short life for the cell and a minimum of service rendered. In military operations, where the dry cell must function perfectly at all times, carelessness in handling and lack of understanding of operation might have costly results.

Instruction should provide understanding of voltaic cell theory, with emphasis upon polarization and other causes of cell failure. The dry cell's construction may be studied, with emphasis on the care needed in its effective handling. Students should learn that every type of dry cell as a definite rate of discharge at which a maximum of power is delivered. The effect of grouping primary cells in different arrangements to form batteries ought to be carefully noted.

Illustrative Activities

1. Simple voltaic cells may be constructed with various substances as electrolytes and different conductors for the electrodes. Use these to operate bells or buzzers. Allow the bell to operate until no further action occurs. Discussion and reading should result in an understanding of the polarization which impeded the flow of ions. Refer to de-polarizing substances and their use in commercial dry cells.
2. Examine the construction of a dry cell. Discussion may be focused on causes of failure such as lack of use, shorting, final erosion of the zinc can, breakage of the seal. Examine flashlight cells which have become badly eroded.
3. In cases of extreme need, a spent dry cell may be made to operate again for a limited time by pnching holes in the zinc can and soaking the matrix with any salt, acid, or alkali solution. To experiment with worn out cells in order to determine what electrolytes are best, attach them to a bell or buzzer to determine the life of the rejuvenated cell.
4. Construct voltaic cells of various sizes (using the same electrolytes, anodes, and cathodes). Attach to voltmeters and ammeters to determine if differences in potential and in current are produced by these cells. Students should discuss the advantage in longer life of the larger cell despite the fact that no greater voltage or current is produced.
5. Attach the cells in series, parallel, and series-parallel arrangements, and determine the differences in potential by using a voltmeter.
6. Examine the construction of worn out "A" and "B" battteries, and account for the voltages and relative battery life given on the packets of the batteries.

IV. THE STORAGE BATTERY

THE STORAGE battery is indispensable in military operation, It is an integral part of every kind of automotive equipment that the Army uses, from motorcycle to airplane. Amphibian tractors, tanks, trucks, self-propelled artillery, ambulances, and service cars of all

types, make varied but definite demands upon their batteries. Instrument panels are illuminated, guns fired, engines started, ignition supplied, tank turrets operated, and communication and many other functions served by current flowing from storage batteries.

As the life and service of such batteries depend largely on the care they receive, the student will readily appreciate the importance of understanding the battery and its operation.

Instruction may include nomenclature of the battery parts; the action occurring within the battery when it is charged, discharged, and over-charged; and the construction of the commercial lead battery. Of particular interest is the structure of the batteries used in airplanes, which are so designated as to prevent the loss of electrolyte and permit the uninterrupted operation of the battery during comparatively short periods of continuous flight at sharp angles or even upside down. There is also a special battery for radio, so designed as to permit venting of gases and to prevent loss of electrolyte; it is necessary to fill the cells of this battery with a hypodermic needle.

THE STUDENT should become familiar with the causes and prevention of battery failure such as buckled or broken plates and separators, clogged separators, corrosion of terminals, use of non-distilled water in the battery, and the results of leaving the battery discharged over a period of time, as well as the results of overcharging. He should have experience in testing batteries with the hydrometer under varying conditions of temperature, an dshould know the composition and strength of electrolytes.

Illustrative Activities

1. The fundamental operation of the storage battery may be observed by placing lead plates in dilute sulphuric acid and connecting them to a 50-watt lamp or to a buzzer or ammeter. The "discharged" cell will produce no current, of course. Using a source of 120-volt direct current, charge the cell for fifteen or twenty minutes. The formation of lead peroxide should be noted on the negative plate of the cell. The cell should again be connected to a lamp buzzer or ammeter and the results noted.
2. The action of the commercial storage battery may be studied by removing a positive and negative plate from a discarded battery and repeating the above experiment.
3. Students may check the condition of the batteries in their automobiles by observing the condition of the cables, battery case (looking for cracked seals), noting whether or not the electrolyte covers the plates completely, checking the specific gravity with hydrometers, and observing the extent of corrosion. Discussion based upon the examination of batteries should be directed toward correct battery care and the common causes of battery failure.
4. The danger of overcharging may be made clearer if the students observe the nature of the negative plates and see the lead peroxide stamped into the grids. (Overcharging results in heavy, grainy deposits of lead peroxide on the negative plate. These tend to drop away from the plate and fall to the bottom of the battery.) A simple electroplating outfit may be made by using copper sulphate for the electrolyte, copper for the anode, and any piece of clean metal for the cathode. Note the difference in the plating when the current is small as against that when the current is large. It will be observed that the copper may be wiped off if the plating current is excessive. This is identical to the problem involved in too-rapid charging or in over-charging of storage batteries.
5. Readings and discussion should aid the student to understand the necessity of maintaining the specific gravity of the electrolyte above a minimum level. Sulphation has ruined many batteries. Since military operations depend heavily on a reservoir of batteries which may not be needed or used over long periods of time, the soldier who maintains these supplies must keep the batteries in a state of charge.

Contniued on page 36

A Conservation Project

ELEANOR M. BERENDSEN
Illustrations by Beatrice Schafer

Miles Standish School — Cleveland, Ohio

Upper grade and high school teachers may well profit from the excellent methods here presented in the lower grades.—EDITOR.

MUCH WORK in conservation had already been done in the upper elementary grades at Miles Standish School by the Park Protection Club, Children's Conservation Corps, and home gardening groups, with a resulting greater respect for public and private property and appreciation of the value of resources.

However, continued destruction, waste, and carlesness on the part of many, showed a need for beginning the teaching of conservation with the younger children, in order to establish good habits at an early age, which might prevent instead of cure.

With this in mind, a Conservation Unit for Second Grade was planned and carried out.

We started with this question:

How Can We Take Care of Our Neighborhood?

1. The park.
2. Our neighbors' yards.
3. The streets.
4. Our own yards
5. The school yard.

A brief résumé of procedure follows.

We took a trip to the park to observe the beautiful trees, lawns, hedges, shrubs and statuary. Attention was called to signs—*Keep Off the Grass, Do Not Pick the Flowers,* etc.

We walked past homes to see neighbors' yards and gardens, observing condition of lawns, trees, hedges, etc.

Later, at school, the children suggested things they might do to help take care of the park, neighbors' yards and the streets.

Lists were written on the blackboard.

How Can We Take Care of the Park?

1. Keep off the grass.
2. Do not break shrubbery or run thru hedges.
3. Do not break branches of trees or cut the bark.
4. Do not pick flowers.
5. Play only in marked play places.

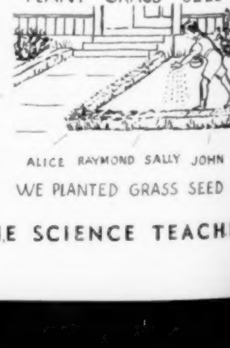
How Can We Take Care of Our Neighbors' Yards and the Streets?

1. Stay on walks going to and from school.
2. Do not take short cuts thru neighbors' yards.
3. Put papers and rubbish into containers at school, on the street, or at home.

Paper dropped on the street iooks ugly and may be blown into people's yards.

The children drew pictures of the places in the park that they liked best.

They made a scrap book of pictures of beautiful trees, flowers, lawns, gardens, birds and animals.

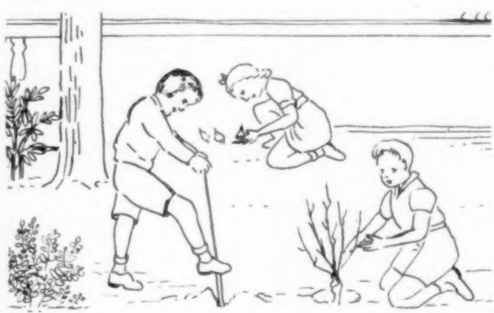


How Can We Take Care of Our Own Yards?

Children told what they could do to take care of their own yards.

1. Clean up.
2. Rake the lawn.
3. Mow the lawn.
4. Dig out weeds.
5. Help trim hedges and shrubbery.
6. Plant grass seed.
7. Plant flower bulbs.
8. Plant a flower or vegetable garden (in season).

A SEPARATE chart for each item listed was made and illustrated. To stimulate interest in actually doing the work, a paper pocket was pasted below each chart for name slips of children who reported from time to time on work they had done at home.



Our Schoolyard

1. *The Playground*

Ways of keeping the playground clean were discussed. A committee was chosen to clean up every day. All the children were to help by throwing refuse into proper containers.

2. *The Planted Areas*

We took a walk around the planted areas in front of our school to observe lawns, hedges, shrubs and trees; to notice conditions and to see if anything was in need of care.

This was followed by a classroom discussion of ways in which we might help take care of our front school yard. Many practical suggestions were made.

We decided to choose one small plot most in need of attention, on which to concentrate our efforts to give it all the care it needed.

This particular plot was overgrown with crabgrass. The shrubs planted along a wall at the back had many dead branches. Some of the hedge plants bordering three sides were half dead or had died out, leaving unsightly stumps. The bark of a young oak tree had been deliberately cut. Besides this there were leaves, sticks, scrap paper and other rubbish scattered about. The task ahead was no small one.

We made a blackboard list of the work to be done.

Our plans

1. Clean up.
2. Rake the lawn.
3. Dig out weeds and crabgrass.
4. Plant grass seed.
5. Cut dead wood out of shrubs.
6. Dig out old stumps of shrubs and fill in the hedge with new plants.
7. Cover tree cuts to keep insects out.
8. Plant flower bulbs.

THEN WE were presented with another problem. To accomplish these things we would need money. Where would we get the money?

Coat hangers were much in demand by dry cleaners just then. A coat hanger collection and sale netted us $5.50.

With some of the money we bought grass seed, fertilizer, 25 Privet hedge plants, and a few tulip and narcissus bulbs.

The children brought their own garden tools from home and set to work. A short period each day was devoted to the task. As each thing was accomplished, it was checked off the list. Eventually all were completed, much to the satisfaction of pupils and teacher. The children made and painted a wooden sign *Please* which they set up in the yard.

Trees

A discussion of trees and their usefulness brought home to the children reasons why we should take care of the trees, not break branches or cut the bark; cover cuts to prevent decay and to keep insects out.

Birds

Then came the study of birds and how they help to preserve the trees and other plants by eating harmful insects.

We discussed ways of helping birds in winter when it is hard for them to find food.

The children made twenty three feeding stations of old wood, orange crates and cigar boxes. With money left from the coat hanger sale, we bought paint and bird food. From an article in the Cleveland Plain Dealer we learned what to feed the birds.

ONE FEEDING station was hung in a tree at school where birds could be observed. The others were taken home. From time to time children reported on birds seen at their own feeding stations.

A birds' Christmas tree, an evergreen in the school yard which the children decorated with strings of pop corn, furnished much pleasure and at the same time served a worthy cause.

The unit on Care of Our Neighborhood was followed by three others—

1. Care of school materials.
2. Care of clothing.
3. Health.

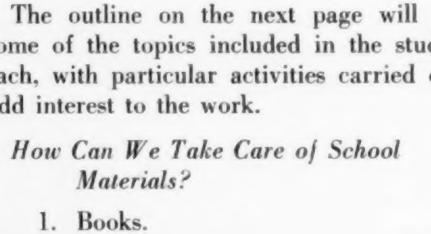
The outline on the next page will show some of the topics included in the study of each, with particular activities carried on to add interest to the work.

How Can We Take Care of School Materials?

1. Books.
2. Crayons.
3. Paper.
4. Pencils.
5. Paste.
6. Desks.

Pictures of these school materials, made by the children, were pasted on a reminder chart with the caption—Can you make these things last longer?

CAN YOU MAKE THESE THINGS LAST LONGER?



How Can We Take Care of Our Clothes?

1. Keep clothes clean.
2. Wear aprons when we work.
3. Wear play clothes for play.
4. Hang up clothes that are not being worn.
5. Wear rubbers or boots to keep shoes dry.
6. Polish shoes to preserve the leather.

Each of the above items necessary for proper care of clothing was illustrated with a large colored chalk drawing, appropriately titled and hung in the classroom.

COVER UP EACH COUGH AND SNEEZE
IF YOU DON'T YOU'LL SPREAD DISEASE

How Can We Keep Ourselves in Good Health?

1. Cold prevention.
2. Sleep.
3. Food.
4. Care of teeth.
5. Care of eyes.
6. Posture.

As a reminder to bring a clean handkerchief to school every day and to use it when needed, we made a chart with a display of paper handkerchiefs to represent those the children had at school each day and headed it with the rhyme—

Cover up each cough and sneeze,
If you don't, you'll spread disease.

Standards for a good breakfast, a good lunch, etc., were set up by having a tray for each meal set with paper stand-up pictures (made by the children) of representative good foods.

The Children's Conservation Corps

AN OPPORTUNITY to join the Children's Conservation Corps, sponsored by the

Continued on page 48

News and Announcements

SCIENCE EDUCATION FELLOWSHIPS

The following fellowships and assistantships are available to students in Nature Study and Science Education at Cornell University, Ithaca, New York.

a. Two or three research fellowships of $400 to $600 in Nature Study and Conservation Education. Free tuition not included.

b. One $150 scholarship given by the late Anna Botsford Comstock and available to graduate students in nature study.

c. One $500 assistantship and free tuition in Cornell University available to a person of experience preparing for a leadership position in the teaching of science.

d. Two $725 assistantships and free tuition in Cornell University available to persons of superior preparation and teaching ability for part-time assistance in the directed teaching program carried on in the Ithaca High School.

Applications should be on file if possible by March 1. For application blanks and further information — address: Director, School of Education, Stone Hall, Cornell University, Ithaca, N. Y.

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Russian-American Science Committee

AN OUTGROWTH of the recent Congress of American-Soviet Friendship was the formation of the Science Committee of the National Council of American-Soviet Friendship, with headquarters at 232 Madison Avenue, New York 16, N. Y. Among its members are eminent American scientists of international fame, with Professor Walter B. Cannon, of Harvard University, as Honorary Chairman. Among far-reaching plans of the Committee are the publication of translated abstracts of Soviet scientific literature, the production of a Russian-English Scientific Dictionary, and the establishment of direct personal exchange between American and Soviet scientists of papers and information.

The Committee proposes that the United States establish a Scientific Mission in the Soviet Union similar to the ones already established by the Australians, New Zealanders and British.

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WRITE FOR IT

New Crops for the New World. The Middle America Information Bureau, organized by the United Fruit Company, 9 Rockefeller Plaza, New York 20, New York. Three pages, reprinted from the Nation's Business, August, 1943.

Health and Liquids. American Bottlers of Carbonated Beverages, 1128 Sixteenth Street, N. W., Washington, D. C. An eight page booklet with bibliography discussing the functions of liquids in the body. Can be used in junior high school as well as with biology classes.

Visual Aids Catalog-Directory. The Jim Handy Organization, 2900 E. Grand Blvd., Detroit, Michigan. A new and improved type of visual aids catalog-directory, titled, "Slidefilms and Motion Pictures, to Help Instructors" will be sent free upon request to any teacher, school, college or educational group. By a new system of indexing, cross-indexing and classifying, teaching slide films and motion pictures, covering a wide range of studies, the teacher is enabled to quickly locate any subject needed. Listings are made under the curriculum system, and it has been found that muct time and labor is saved for the instructor. Another feature shows which types of projectors are best suited to various visualized teaching purposes.

★

COMING

Another feature on the front edge of science both in war and peace is "Frequency Modulation and Its Place in Post War Broadcasting" written especially for us by A. James Ebel, Chief Engineer of Station WILL, University of Illinois. Here is something that completely "out-foxed" the Germans in North Africa.

FUNDAMENTALS OF ELECTRICITY

Continued from page 31

V. VOLTAGE, CURRENT, AND RESISTANCE

Five miles of wiring are said to be used in the Liberator Bomber—only two thousand feet are required in the average six-room house. Through the essential wiring, cells, batteries and generators supply current to meet a great variety of military needs. Skill and speed in tracing circuits and in repairing wiring might easily have life or death value to the soldier in an armored tank, for example, if the shocks and strains due to battle result in current interruptions.

FOR PRE-INDUCTION training it is suggested that in this area, the teacher limit demonstrations, discussion, and other learning experiences to a consideration of practical problems involving pressure, resistance, and current flow. The analogy of water flowing through a pipe is often successfully used.

Factors such as size and number of plates in a cell, or battery of cells, may be studied in relation to pressure, current strength, and resistance as seen in common electrical devices of the home, especially those having counterparts or similar uses in military life. Provision should be made for the student to have abundant experience in setting up and testing circuits with battery connections made in series, parallel, and in simple series—parallel. The "short" circuit should be especially noted. Due consideration should be given to factors influencing internal as well as external resistances. Through these experiences Ohm's law, basic to an understanding of electricity in motion, will become more meaningful than if arbitrarily memorized.

Illustrative Activities

1. Three or four dry cells in series may be connected in series first with iron, and then with copper, aluminum, and nichrome wires in turn, to determine their relative resistances. A voltmeter should be connected across the circuit and an ammeter in series with the circuit. With this simple hook-up the basic operation of Ohm's law may be observed and studied.
2. The above activity may be repeated using a single wire and a sliding contact to study the relationship of resistance to length of conductor, and to copper wires of different diameters.
3. The resistances of such electrical devices as an electric bell may be determined in a similar fashion. The voltmeter should be connected across the terminals of the bell, and the ammeter in series.
4. The effect of temperature on resistance may be studied by connecting a light bulb, ammeter, and suspended coil of iron wire in series with the 110 volt convenience outlet, and heating the iron coil with a Bunsen burner.
5. The operation of Ohm's law in parallel and series circuits when resistances are added or the voltage is charged should be analyzed. Sample circuits with known resistances may be set up and voltmeter and ammeter readings taken. Students may compute the resistances and current strength in parts of the circuit and in the entire circuit; these data should be checked against the known resistances.
6. Students should undertake practical laboratory problems in which they install such devices as irons, toasters, lights, and fans in series and in parallel with an 110-volt power supply. Various series and parallel circuits may be specified and the student given the practical experience of hooking up a number of these common appliances and heating elements on given circuits. The voltage drops, current, and resistances should be studied by use of voltmeter and ammeter, and the application of Ohm's law noted.
7. Students should become proficient in tracing simple wiring circuits. The automobile electrical system) and a typical home wiring system are particularly useful for study. A desirable activity would be the production of circuit diagrams in which the conventional symbols are used. A model wiring circuit of the automobile, constructed on plasterboard, may also be devised. If storage battery, lights, distributor, automobile ammeter, etc., are obtain-

able, these may be placed on the "mock-up" wiring for a more realistic model of the automobile circuit. The teacher may find that the school shop has a model circuit which could be studied or that the shop instructor will arrange to demonstrate the wiring system of an automobile to the electricity class.

(Concluded in the April issue.)

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HYSTERIA vs. HAPPINESS

Continued from page 19

action, but, failing to find a satisfactory mode of action, behaves in a manner seemingly designed to draw his loved ones to a point of exasperation. On the other hand, you have seen the parent and sometimes the teacher, unable to cope with the adolescent behaviour, herself growing hysterical. People unable to resolve their personal problems sometimes seek the advice of friends or ministers or of Mr. Anthony, or, for that matter, may take their cue from a bigoteer or a demagogic dispenser of propaganda. Sometimes the mere blowing off of steam is sufficient activity to relieve one's emotional conflict. One who is looked to for advice must have a good understanding of human behaviour. Otherwise, counsel given with the noblest of intentions may only give rise to new situations that will, in turn, have to be resolved.

Problems resulting from employer-employee relationships are being resolved through labor-management cooperation. Conflicts are resolved into desirable activity, avoiding damaging acts by the individuals involved. Thus, war production is enhanced, and unhappiness avoided. This kind of relationship is sure to continue after the war simply because it has proven its value. Similarly, we shall continue, even enhance, international cooperation during the peace following the war if we remember its value in the prosecution of the war itself. We should not permit international cartels to again usurp the province of government. We should encourage the international cooperation of labor, of science and of medicine.

WITH INDICATIONS of pending curtailment in steel and aluminum production, come fears of unemployment, combined with fears of a rising cost of living. This is coupled to evidences of powerful and social forces such as is evidenced by the following statement made recently by an influential investment banker: "Full employment would be incompatible with the free enterprise system which carries with it the right to a normal float of enemployed." (John F. Fennelly addressing Investment Bankers Association, New York City, November 4, as quoted by *In Fact*, January 3, 1944). We shall be wise to adopt a determination to continue a program of ever increasing production for peacetime consumption as we have done for war production. Mental stability will be further enhanced by providing for an extension of social security laws to include all of our people, and for expansion of security provisions to make available to all the benefits which modern medical science can provide, as envisaged in the Wagner-Murray-Dingell Bill now before Congress.

Rats, or, for that matter, any animals in their natural habitats, are not known to develop ticks or other forms of neurosis. It was only under the impact of a manipulated environment that Maier's rats developed abnormal behaviour. Civilized man has enveloped himself in an artificial environment, thereby bestowing upon himself certain benefits. But, with these advantages, have come psychological problems. The same intelligence man used to modify his surroundings he can use to adjust this environment in such ways as to resolve his conflicts, that is, to make himself happier. ★

Have your heard about the CORONET Picture Stories? This is a series of slidefilms prepared from the Picture Stories in Coronet magazine. The September issue is "Through the Periscope," for October "China Fights Back," and in November there will be a full natural color slidefilm on the United States Navy. The charge per film is 25 cents or $2.00 for the entire series of 8 slidefilms. If you prefer you may get 25 reprints of each set of pictures for study by individual students. The 8 sets of 25 reprints is $2.00. Order from Society for Visual Education, Inc., 100 East Ohio Street, Chicago (11), Illinois.

PENDULUM DEMONSTRATION

Continued from page 17

NOW WE have an appartus containing pendulums of different shapes, but of the same length. If they are started together, they will immediately diverge, no two vibrating in the same time. As pendulums, they are not of the same length. When this is presented to the class for observation, interesting questions as to this behavior are raised by the pupils. In the simple pendulum, they learned that the center of gravity or the point where the weight is concentrated determines the length. Surely this must be true here also. Well, let us see. Determine time of one swing for each of the four pendulums in turn. By using the formula[1] $l = \frac{qt^2}{\pi^2}$, the pupil may determine the length of each. The class will be surprised to learn that this point determined cannot be the center of gravity or the point where the weight of the stick is concentrated. In the case of pendulum No. 2 it is about ⅔ of the way down from the point of suspension.

Now the class arrives at the point in the discussion where the vital question relative to pendulums is to be answered. Allow them plenty of time for the discussion among themselves, without disclosing the real reason unless it is developed by some member of the class. It probably will be. Simply direct the activity.

Christian Huygens, a Dutch mathematician and astronomer, in 1673 discovered that the point of suspension and the center of oscillation are interchangeable. If, therefore, a pendulum be inverted, and a point found that will vibrate in the same time as before, this is the former center of oscillation while the old point of suspension becomes the new center of oscillation.

CAPTAIN Henry Kater of the British Navy, one of the foremost authorities on the pendulum, devised, in 1818, a pendulum which in college physics is still referred to as Kater's Pendulum and is used to make very accurate

1—*The Science Teacher.* Vol. 9 No. 3. October 1942. Apparatus to Demonstrate Fallind Bodies. Page 31.

determinations of the gravitational constant "g" in various latitudes. Captain Kater in his book "A Treatise on Mechanics," published in 1831, suggests an interesting demonstration using four balls. First they are suspended to vibrate independently in one-fourth second, one-half second, three-fourths second and one second respectively, these four balls are then fastened on a rigid wire at the same distances from the point of suspension as when swinging independently. It will be noticed that the upper balls will tend to hasten the period of vibration while the lower tend to retard it. He says[2] "If, instead of supposing four particles of matter placed on the wire, a greater number were supposed to be placed at various distances from the point of gyration, it is evident the same reasoning would be applicable. They would mutually affect each other's motion: those placed nearest to the suspension accelerating the motion of those more remote, and being themselves retarded by the latter. Among these particles one would be found in which all these effects would be mutually neutralized, all the particles nearer the suspension being retarded in reference to that motion which they would have if unconnected with the rest and those more remote being in the same respect accelerated. The point at which such a particle is placed is called *the centre of oscillation*." He further states: "The investigation of the position of the centre of oscillation is, in most cases, the subject of intricate mathematical calculation. It depends on the magnitude and the figure of the pendulus body, the manner in which the mass is distributed through its volume, or the density of its several parts, and the position of the axis on which it swings."

2—Kater, Capt. Henry & Lardner D. : A. Treatise on Mechanics. Published by Stimpson & Clapp. Boston. 1831. Pages 129 and 129.

THIS DEMONSTRATION will serve to require from the pupil further use of his mathematics concerning the pendulum. He will be introduced to new concepts, such as center of oscillation, and the center of percussion. The latter is the same as the center of oscil-

Continued on page 43

INSECTS IN WAR TIME

Continued from page 22

For the chewing insects, the most important stomach poisons are lead arsenate, cryolite and Paris green, a small supply of which every crop grower should have on hand for prompt use when he first detects the injury by chewing insects. These stomach poisons are used in two principal ways: First, the entire plant to be protected is covered so thoroughly with a thin film of lead arsenate or cryolite, that the insect cannot eat a single meal without getting a fatal dose of the stomach poison. There is one important restriction to be kept in mind: These substances are not only deadly to insects, they are violent poisons for man if swallowed. Therefore they should not be applied to parts of plants that are to be eaten, unless you can be sure that the poison film will be washed off, before the vegetables or fruits are eaten or sold to other people.

For example, these stomach poisons should never be sprayed or dusted upon lettuce, celery, asparagus tips, chard, or ripening fruits. They can be applied safely to the leaves of root crops such as potatoes, carrots, and turnips, without any danger that the poison will be taken into the underground roots or tubers. They can be applied safely to the foliage of tomatoes, beans and peas, until the pods or fruits begin to form; and to cabbage plants while they are small, but not after the heads are well formed unless you are sure that all outer leaves, which catch any of the poison, will be discarded before cooking. They can be applied to fruit trees until the fruits are approximately half grown; but, if applied on maturing fruits, the fruit must be washed in a special acid bath before using or selling it, because these poisons stick like paint to sprayed plants, for weeks or months, and might be present in sufficient amounts to harm the consumer, unless the above precautions are observed.

THE OTHER method of using stomach poisons for insects is to mix them with some substance known to be very attractive to the particular insect, and exposing these "poisoned bait" mixtures where the insects can easily get them; but in such a way that human beings, domestic animals and wild birds will not be endangered. A very important use for poison baits is to control grasshoppers, cutworms and armyworms. For this purpose an ounce of paris green should be very thoroughly mixed with a pound and a half of coarse wheat bran; separately mix a fourth pint of black strap molasses in a pint of water. Then mix the poisoned bran and the sweetened water together, so as to make a moist mash, and scatter thinly over the garden soil and adjoining fencerows and weedy field margins. For grasshoppers spread the poisoned bran before sunrise; for cutworms and armyworms at dusk. Ten pounds of bran will make enough bait for an acre of ground.

For insects such as thrips which puncture the foliage of onions, cabbage, gladiolas and many other ornamental flowers, and suck up the say that exudes, a poison bait may be sprayed over the foliage of the plants and they will drink it in, as they do the oozing sap. For this purpose, 2 ounces of tartar emetic and ½ pound of brown sugar should be mixed in 3 gallons of water and the mixture sprayed over the plants so as to cover all surfaces.

The stomach poisons can be used *in a preventive way*, before the chewing insects appear or any damage is noticed, and will remain clinging to the foliage for weeks to kill any chewing insects that subsequently attack the plants. Such general preventive or cover sprays should be used upon such crops as potatoes, tomatoes, cucumbers, melons, cabbage and fruit crops, which are so certain to be attacked that it generally pays to spray them every ten days, so as to keep all new foliage covered and safe from injury.

FOR PROTECTING melons and cucumber plants from the attacks of the common, black and yellow, striped cucumber beetle a dust made by mixing calcium arsenate in nine or ten parts, by weight, of burned gypsum should be applied liberally, all over the plants once a week from the time they come up from the seeds. Since the squash bug, a very common and troublesome piercing-

sucking insect is likely to attack squashes, melons and cucumbers at the same time as the striped cucumber beetle, adding two parts by weight of fresh pyrethrum powder to the above mixture and applying it at the rate of 5 to 25 pounds per acre, depending upon the size of the plants, gives good control of both these pests.

[CONCLUDED IN APRIL ISSUE]

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OBSERVATION ON CROWS

Continued from page 27

the young crows from the nest and began raising them at home.

The greatest problem confronting me in my home project was the problem of feeding. The crows were fed on a scheduled diet which was carried out as nearly as possible to natural feeding schedules and diets of crows. The crows were fed all types of insects, small pieces of meat, and water soaked bread. This diet was continued and was modified somewhat when the crows began flying.

THE TWO groups of crows developed at about the same rate, and at the age of five weeks both groups began flying. The periods required for the crows to master flight varied from three to eighteen days.

At six weeks the crows in the woods left their nest and here my observations on them terminated. The next few months of their lives will be spent in a family group traveling from one locality to another.

My own home project was getting along nicely when suddenly two of the crows died. Death probably resulted from a deficiency of something in the diet. The third was unaffected. At this stage, the crows were seven weeks old.

The remaining crow is now nine weeks old and developing rapidly, but as yet he has not strayed. He is also very popular with the neighborhood children and may be seen with a group of playing children almost at any time.

PENDULUM DEMONSTRATION

Continued from page 39

lation, and is the point where we must strike a suspended body, if we wish it to revolve about its axis without any strain. The center of oscillation of any rod is also the center of percussion. If a ball is hit at the center of percussion of a baseball bat, the ball will receive the greatest force from the bat. If the ball is struck at any other point, the blow will cause the bat to vibrate and may break the bat or sting the hand. Many other illustrations may be suggested by the class.

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COLLOIDAL GRAPHITE

Continued from page 15

mand for more and more supplies of war requires that both man and machine function at top speed. High speed operation of machinery results in constant wear upon moving parts and this wear would be greatly accelerated if a lubricant were not available which helps to keep this at a minimum. Decreased friction insures long life to machinery. The limit of speed of operation of machinery has probably not been reached yet, so far as a safe lubricant is concerned. And this is being made possible through the magic of colloidal graphite.

LITERATURE CITED

1. Acheson Colloids Corporation, Technical Bulletins Nos. 10.1;92.13;130 14;270.60.
2. Brodie, B. C., Roy. Soc. London, Phil. Trans., 149, 249-59 (1859.
3. Elder, Albert L., Textbook of Chemistry, 670-672, (1941) Harper & Brothers, New York, N. Y.
4. Finch, G. I., Quarrell, A. G., and Wilman, H., Trans. Faraday Soc., 31, 1051-80, (1935).
5. Finch, G. I., and Whitmore, E. J., Engineering 146, 91, (1938).
6. Finch, G. I., and Quarrell, A. G., Nature, 137, 516-19 (1936).
7. Fink, C. G., and Prince, J. D., Trans, Am. Electrochem. Soc. 54, 315, (1928).
8. Moissan, H. Compt. rend., 116, 608-11, (1893).
9. Porter, B. H., Illuminating Engineering 46, 499-502, (1941).
10. Porter, B. H., Rev. Sci. Instruments, 7, 101-06, (1936).
11. Szymanowitz, Raymond, J. Chem. Educ. 16, 413-22, (1939).
12. Szymanowitz, Raymond, J. Chem. Educ. 3, 909-14, (1925).
13. Szymanowitz, Raymond, J. Chem. Educ. 18, 331-32, (1941).
14. Szymanowitz, Raymond, U. S. Patent No. 2,047,087 assigned to Acheson Colloids Corporation.

NEW BOOKS

Understanding Radio. Watson, Welch and Eby; all of Stockton Junior College, Stockton, California. McGraw-Hill Book Company, New York City, 1940. 603 pp., 13.5x20.5 cm. 382 illus.

Applied Mechanics and Heat. L. Raymond Smith, Dickinson High School, Jersey City, N. J. McGraw-Hill Book Company, New York City, 1943. Prepared in conformance with official pre-induction training course outline No. PIT 102. 326 pp., 12.5x19 cm. 296 illus. $2.00, list.

The Story of Flying. Archibald Black. Revised edition. Whittlesy House, New York City, 1943. 272 pp., 14.5x22.5 cm. illus. $2.50.

Practical Physics. Marsh W. White, Kenneth V. Manning, Robert L. Weber, and R. Orin Cornett, all of Harvard University. McGraw-Hill Book Company, New York City, 1943. 365 pp., 15x22.5 cm. illus. $2.50.

One Thousand Pre-Flight Problems. Thompson and Aiken. Harper and Brothers, New York, 1943. 166 pp. Paper, 88 cents; cloth, $1.20.

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EDUCATIONAL FILMS PROGRAM

Continued from page 25

through, then sent to me in 116 for repair, before being rewound.

VI. Projection

A COMPLETE schedule for the week is made up from the committee reports, which each member has secured from his department.

A completed schedule is then posted on the bulletin board in the main office, and also a copy on the director's bulletin board. These bulletins provide specific directions to operators, teachers, and directors alike. A copy of a typical completed schedule for one week is reproduced on page 25.

(Concluded in April issue)

COUNCIL NOTES

Continued from page 11

supplemented at the teachers discretion—will indicate desirable approaches to sound pre-induction instruction in health.

FOUR FIELDS are suggested for emphasis in the pre-induction training of each individual who anticipates military service. These fields, determined by an analysis of health needs of the armed forces, represent a common health denominator equally important to the infantry machine gunner and the naval gunner, to the radio operator, the tank mechanic, and the pilot. Obviously, certain jobs and unusual military conditions may require special post-induction training in health; but this will be for the most part an addition to the basic training here recommended for pre-induction instruction.

The four fields suggested for emphasis in the report are: Adjustment to Military Life, An Introductory Unit; The Fighting Man and His Diet; Prevention and Control of Communicable Diseases; and, Emergency Care and Prevention of Accidents in Military Life.

THIS REPORT on pre-induction training in health, sanitation, and first aid is an example of a cooperative effort involving a number of science teacher organizations. The results are almost certainly superior to any product which could have been achieved by any one single organization. There are numerous similar and related problems today which merit the same cooperation and practical results. It seems well established that the immediate post-war period will bring a new group of equally important problems which will merit continued cooperation. Perhaps it's safe to say that no period in the visible future will be without such problems. The example of this Pre-Induction Health report is suggested as one answer to the often repeated question of what might be achieved by cooperation.

BOOK SHELF

PRINCIPLES OF AIR NAVIGATION. Bert A. Shields, Lt. Comdr., U.S.N.R. Formerly Chief Instructor in Charge of Civilian Pilot Training, Polytechnic Institute of Brooklyn. McGraw-Hill Book Company, New York, 1943. 451 pp., 12.5x19.5 cm. 240 illus.

Principles of Air Navigation is the third book in the *Introductory Aviation Series* written by Bert Shields for the purpose of interesting students in the various branches of aviation and at the same time providing as much useful knowledge as possible. This book explains the various types of aviation charts and describes their use, also the instruments necessary in navigation. Much of the text is given to a study of aviation problems and explains in considerable detail their solution. One chapter deals with radio navigation. Both cross country and over water navigation are included.

The books in this *Aviation Series* are so planned that two can be covered in one semester. They are well organized and should be easy to use in class instruction.

LIBERAL EDUCATION. Mark Van Doren. Distributed by Henry Holt and Company, New York, 1943. 186 pp., 13x21 cm. $2.50 list.

In this period when education is being limited and fashioned by war necessity, it is most refreshing to find a book so challenging and thought provoking as Van Doren's *Liberal Education*. There in is presented a very clear and understandable discussion of one world's intangibles which for any individual is difficult to analyze and impossible to exactly measure. Also the means of securing an education—the school, its curriculum, and the teacher—are held up for inspection.

The book is a masterpiece and belongs with one's treasures in the education field. The reviewer feels his inability to do it justice and can only suggest that any one in the field of education, and this includes science education, will instantly recognize the book as a classic. However, it is one that is easily read, that will be re-read and enjoyed. For those who like to think it will be most stimulating.

A PRIMER OF ELECTRONICS. Don P. Caverly, Commercial Engineer, Sylvania Electric Products, Inc. McGraw-Hill Book Company, New York, 1943. 235 pp., 13x19.5 cm. 125 illus. $2.00 list.

This book is not a text, but is excellent as a reference book in electronics in high school and college for those who want a simple explanation unburdened with the mathematical formula required for engineers. It was originally written for non-school people who needed to know something about the things they use which means that can be asily understood.

The book begins with the atom and the electron and takes the reader on and through to an understanding of simple radio tubes and even some knowledge of electro magnetic radiations that are today used in warfare in radar work. The explanations are very clear and simple.

MATHEMATICS OF FLIGHT. James Naidich, Chairman, Department of Mathematics, Manhattan High School of Aviation Trades, New York City. McGraw-Hill Book Company, New York, 1943. 409 pp., 15x23 cm. 396 illus. $2.75 list.

Mathematics of Flight is designed as a basic text in the high school for those wanting a mathematical background for flight. It gives a review of algebra and that part of geometry useful in the area. This is followed by the essential principles of trigonometry applied in practical situations in aeronautics. Finally the mathematical principles are applied in the latter half of the book to aerodynamics—the principles of flight.

DYNAMIC BIOLOGY TODAY. Arthur O. Baker, Supervisor of Science in Junior and Senior High Schools, Cleveland; Lewis H. Mills, Principal of William Dean Howell Junior High School, Cleveland; William L. Connor, Member of Legislative Committee on the State Education of State of New York. Rand McNally and Company, Chicago, 1943. 822 pp., 15x22 cm. Illus.

Dynamic Biology Today is noteworthy in at least two ways—first, the subject matter is well organized in terms of present day needs and interests of the pupils; and second, the mecahnical presentation immediately appeals to the eye and gives to the student with a minimum of effort a general idea of the problem presented.

The organization used, grouping facts and principles around problems of personal and social significance, makes the subject a vital one and helps the learner to relate the principles to life in his community.

Questions are given at the beginning of each unit to arouse interest and orient the student. At the close are useful activities that involve organizing and using the material studied.

An outstanding feature of the book is the lavish use of pictures and large diagrams. These make the book an attractive one as well as presenting useful ideas.

WORKBOOK DYNAMIC BIOLOGY TODAY. Arthur O. Baker, Lewis H. Mills and William L. Connor. Rand McNally and Company, Chicago, 1943. 218 pp., 20x27. Illus.

This workbook is designed to cover the work as presented in the text *Dynamic Biology Today* and is organized on the same basis. However, with some adaptations it can be used with other texts and the order of the units shifted as desired.

The organization of units in terms of life problems makes the work meaningful and of real interest to students.

Among the units given are, "The Scientific Approach to Biological Problems," "Taking Part in Recreation for Wider Living," "Making Better Use of Biological Products and Services," How Nervous Responses Affect Human Welfare," and "Using Biological Knowledge in Your Work." These titles indicate somewhat the point of view.

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CONSERVATION PROJECT

Continued from page 34

Cleveland Plain Dealer, stimulated much interest.

Those who learned the pledge and obtained the required home safety supplies had the privilege of becoming members.

To understand part of the pledge, "to preserve and increase all our resources," it was important to learn the meaning of the words, preserve and increase and to know what our resources were.

A list of resources was written on the board, read and reviewed.

1. Plants.
2. Animals.
3. Soil.
4. Water.
5. Minerals (Metals).
6. People.

An inventory of the work we were doing proved that the class had done something to help in each case except that of water. For minerals they had shared in scrap metal and tin can collections. Conservation of water was somewhat beyond their scope.

—ELEANOR A. BERENDSEN.

Illustrations by Beatrice Schafer.